

APPENDIX III

TAB K

Kevin Padian

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 1 Oakland, California, Tuesday, May 10, 2005
 2 9:20 a.m. - 1:52 p.m.
 3
 4 KEVIN PADIAN,
 5 having been first duly sworn, was examined and testified
 6 as follows:

EXAMINATION

BY MR. GILLEN:

11 Q Good morning, Dr. Padian. My name is Patrick
 12 Gillen. We met off the record, but let me introduce
 13 myself again for the purposes of the record. I'm an
 14 attorney for the defendants in this case, Dover Area
 15 School District and the school board, and I'm here
 16 today, as you know, to take your deposition in this
 17 manner. As I see it, to learn the basis for the expert
 18 opinion, which you provided in this case.

19 There are few features of this process that are
 20 somewhat unusual. The first is that the questions and
 21 answers, they're verbal, but we have to make sure that
 22 we wait until -- that all responses are verbal, first of
 23 all. And second, that we wait until each other is done
 24 speaking before we talk so that Ana can get a good
 25 transcription.

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 1 Another part of the process that tends to be
 2 highlighted here is that in precision of human
 3 communication, and I can assure you that after looking
 4 at the report, that there may be -- or there will be
 5 certain areas where I'm struggling just to understand
 6 that basis for your answer. Please bear with me if my
 7 questions are imprecise and tell me that you find them
 8 so, and I'll try to clarify them to the extent I can.
 9 By the same token, you know, if you -- if I struggle
 10 with your answer, please bear with me as I try and
 11 understand them.

12 We are somewhat late, and I regret that. It's
 13 not an endurance contest. If you need a break, please
 14 let me know. If there's any question I ask you that
 15 makes you uncomfortable or something that you don't feel
 16 that you'd like to talk about, please let me know, and
 17 I'll try to avoid that to the extent I can. I think
 18 that's about it for the general protocols.

19 Would you state your full name for the record.
 20 MR. ROTHSCHILD: I'm sorry, before we go on. I
 21 assume we're going to operate under normal stipulations,
 22 all objections, except as to form, are preserved to
 23 trial?

24 MR. GILLEN: I agree.

25 MR. ROTHSCHILD: And I've requested, and you've

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 1 I agreed off the record, that we can have 60 days to read
 2 and sign rather than the usually 30?
 3 MR. GILLEN: Yes.
 4 MR. ROTHSCHILD: Thank you.
 5 MR. GILLEN: No problem.
 6 BY MR. GILLEN:
 7 Q Would you please state your full name for the
 8 record.
 9 A My full name is Kevin Padian.
 10 Q Okay. Current address?
 11 A Home address?
 12 Q Yeah.
 13 A 425 Yale in Kensington, California 94708.
 14 Q How would you prefer that I address you for the
 15 purpose of the deposition?
 16 A First names are fine. It really doesn't
 17 matter.
 18 Q The same with me, please.
 19 A Okay.
 20 Q Have you been deposed before?
 21 A Yes. About maybe ten years ago in a different
 22 case.
 23 Q What case was that?
 24 A It had something to do with the Institute for
 25 Creation Research losing its accreditation in the State

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 1 of California.
 2 Q Was it a state court proceeding, do you know?
 3 A I believe it was state court, yeah. Although
 4 it was so long ago, I don't remember the details.
 5 Q Okay. And you say about ten years ago?
 6 A Yeah. At least, yeah.
 7 Q And it was the Institute for Creation Research?
 8 A Creation Research, yeah, down in San Diego.
 9 And they were -- they were contesting it against Bill
 10 Henig, who was then State Superintendent of Education,
 11 Public Instruction.
 12 Q And for what purpose did you testify in that
 13 proceeding?
 14 A Whether the creation of science that they were
 15 teaching was, in fact, good science that should be
 16 taught in schools.
 17 Q Do you know the result of that proceeding?
 18 A I believe, I think they got their accreditation
 19 back, but I'm not sure. I don't remember the result
 20 anymore.
 21 Q And if you could describe for me, please,
 22 generally, the thrust of your testimony in that
 23 proceeding. Did you address, as you have here, the role
 24 of Paleontology?
 25 A It was so long ago, I can't remember all of the

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1 things that were asked. I don't remember that it took
2 very long, and I think it had to do with why creation
3 science wasn't science.

4 Q Were there other experts who testified in that
5 proceeding?

6 A I don't know. I don't remember.

7 Q Who retained you?

8 A I don't remember that either.

9 Q Okay. Do you know if perhaps the State
10 retained you?

11 A That might have been. And I'm trying to think
12 whether now it was an expert witness or whether they
13 just called me as a witness. I think maybe it was not
14 an expert witness.

15 Q Okay.

16 A I think in that case. So this would be then
17 the first.

18 Q But you answered my question honestly, which
19 is, had you testified in any other proceedings. Is that
20 the only one?

21 A Yes, I believe so. And that was just a
22 deposition, that didn't go to trial with me.

23 Q Now about, have you offered any expert opinions
24 via affidavit or declarations in other proceedings?

25 A Personally no, I don't think so.

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1 not involved with writing them. That's what the people
2 in the office do.

3 Q When you say the "day-to-day work is done by
4 the people in the office," who are you referring to?
5 A The executive director, Dr. Eugenie Scott, and
6 her staff.

7 Q Now, it's my understanding that you have
8 consulted with the plaintiffs in this case prior to
9 being retained as an expert?

10 MR. ROTHSCHILD: When you say "you," what are
11 you referring to?

12 THE WITNESS: The plaintiffs, I'm not sure.
13 Who -- if you're talking about the Dover parents, no, I
14 haven't.

15 BY MR. GILLEN:

16 Q No. And that's -- these are all fair
17 questions. Let me try and make my question more
18 precise.

19 Have you personally served as a consulting
20 expert with the plaintiffs in this action prior to the
21 filing of the lawsuit?

22 A No.

23 Q Do you know if anyone at the NCSC has served as
24 a consulting expert prior to the filing of the lawsuit?

25 A I don't know. You would have to ask when any

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1 Q You say "personally," is there a particular
2 reason?

3 A Because I don't know if you would consider if
4 my -- if the nonprofit organization, of which I am
5 president, offers an amicus brief, which is not me, and
6 that's what I -- do you mean those things?

7 Q I appreciate your -- the forthrightness of
8 your answer. I was going to ask you about the next -- I
9 just want to get a sense for the declaration, sort of
10 something where either at the end of the -- at the
11 beginning of you're sworn or at the end, you say true
12 and correct to the best of my knowledge under penalty of
13 perjury.

14 A Yeah, I don't remember anything.

15 Q But I do know from your report and CV that you
16 are also the head of the NCSC, right?

17 A Yes.

18 Q And you mentioned an amicus brief that was
19 filed by the NCSC?

20 A They may have done so. I don't remember
21 specific cases on this, but -- I mean, if there are
22 such. And I should say that, yeah, I am the -- I'm the
23 president of NCSC. I'm the president of the board, but
24 the day-to-day work is done by the people in the office.
25 And so, I don't really decide about amicus briefs. I'm

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1 of those people were contacted.

2 Q And when you say "any of those people," who are
3 you referring to?

4 A At the staff, whether its Genie Scott and her
5 staff people.

6 Q Okay.

7 A You'd have to ask then when they may have heard
8 of this or what contact they may have had.

9 Q If the NCSC staff had agreed to serve as a
10 consulting expert for the plaintiffs or their attorneys
11 in this case, who would make that decision?

12 A That would be Dr. Scott's decision.

13 Q Who else -- you mentioned her staff. Who else
14 works with Dr. Scott on a day-to-day basis at the NCSC?

15 A Gee, Glenn Branch is our deputy secretary.
16 Mick Natake, which is spelled N-a-t-a-k-e, I think, is
17 on the staff there. We have a couple of people who are
18 accountants and financial people. There is an
19 archivist, Susan Spath is another person who coordinates
20 research. I think Wes Elsberry, which would be
21 E-l-s-b-e-r-r-y, is a researcher there. And Eric
22 Meikle, which is Eric M-e-i-k-l-e. And either people --
23 there may be other people who come and go, but they're
24 not they're with us for a while.

25 Q Of the names you mentioned, do you know if

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1 anyone has served as a consultant to the plaintiffs or
 2 their lawyers in this case?

3 A Before --

4 Q Before the filing.

5 A -- the onset of the filing of the lawsuit? I
 6 don't know particularly what their contacts may have --
 7 there contacts may have been. I'm not that involved in
 8 day-to-day work.

9 Q Do you know if they had contacts prior to the
 10 filing of the lawsuit?

11 A I believe they did because, usually, the way
 12 that NCSC becomes involved in something is that the
 13 organization is contacted by people who are concerned
 14 about the situation, who live there. And the -- the
 15 Dover affair has been going on, I guess, for a long time
 16 before the lawsuit was filed. So it's general public
 17 knowledge.

18 Q Yes. Do you know any names from the Dover area
 19 that you're aware of?

20 A No.

21 Q Have you volunteered to provide this testimony
 22 or are you being compensated?

23 A I'm not being compensated.

24 Q Let me ask you, you've done an expert report in
 25 formulating that report, Kevin, what did you look over?

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1 Now about, did you review the answer that was
 2 filed in this case in connection with preparing your
 3 expert report?

4 A I looked it over.

5 Q Anything else?

6 A I just had the complaint and the response.

7 Q Okay. Apart from plaintiff's counsel,
 8 Mr. Rothschild, and anyone else on the plaintiffs' side,
 9 have you spoken with any other persons in connection
 10 with formulating your opinion? Let me --

11 A When you say "other persons," do you mean other
 12 legal counsel?

13 Q No. Other people at Dover Area High School,
 14 for example.

15 A Oh, no.

16 Q Haven't spoken with the Biology teachers there?

17 A No, I haven't.

18 Q Now about other people at the NCSC?

19 A Yes, I have.

20 Q Who have you spoken with there?

21 A I have spoken with Dr. Eugenie Scott and with
 22 Nick Matzke. And also, briefly, with Glenn Branch.

23 Q Did they provide you with any factual basis for
 24 your report?

25 A I don't recall that they provided any factual

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1 A I looked over most of the references cited in
 2 the back. I spent probably most of the time looking at
 3 the book Of Pandas and People. And many of the
 4 scientific references I already knew fairly well, and
 5 they're cited there for general support for the things
 6 I'm talking about.

7 Q Now about anything else, the pleadings or
 8 papers?

9 A No.

10 MR. ROTHSCHILD: Can you just -- objection --
 11 describe what you mean by that?

12 BY MR. GILLEN:

13 Q Sure. The complaint, the answer?

14 A I received copies of those. So I was generally
 15 familiar with what was going on that led to the
 16 complaint.

17 Q Did you review that in connection with
 18 preparing your expert report?

19 A I looked over it. The focus of my report, I
 20 think, is trying to analyze the role of Paleontology
 21 vis--vis science in general. And on the other hand,
 22 Intelligent Design Creationism as an alternative to
 23 science.

24 Q Yes. I mean, I agree. That's what I get out
 25 of it also.

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1 basis because they are not Paleontologists, and I am.
 2 But I did want them to see whether this -- whether what
 3 I was saying made sense to a reasonable person who was
 4 not a Paleontologist.

5 Q Okay. So if I try and just get a sense for how
 6 you have made an assessment of what's going on in Dover
 7 Area High School, what's the basis for your knowledge
 8 about the events at Dover Area High School?

9 A The account that was -- that has been reported
 10 through various media, including the popular press, my
 11 understanding is that there was an attempt to introduce
 12 Intelligent Design Creationism into the Dover School
 13 curriculum as an alternative approach to evolutionarily
 14 biology. And that, to this end, the text Of Pandas and
 15 People was going to be recommended or used in class.

16 Apparently, 50 copies of the book were at some
 17 point donated to the school library. There was a
 18 statement that was to be placed in the curriculum about
 19 the consideration of ideas, other than evolution, such
 20 as Intelligent Design. And that, eventually, a
 21 statement was read in the public schools by
 22 administrators, apparently because the teachers refused
 23 to read it, stating that -- that the idea of evolution
 24 had problems, and that there were other ideas, and that
 25 people should be open minded. And it was read to the

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 2 1 students by the administrators, and that was it.
 3 2 Q Is your opinion, your expert opinion, premised
 4 3 on that particular sort of factual basis or is it just
 5 4 one that's more generally directed to the role of
 5 Paleontology and addressing Intelligent Design Theory?
 7 6 MR. ROTHSCHILD: Objection. You can answer.
 8 7 THE WITNESS: Gee, those are two kind of
 9 8 different questions.
 10 9 BY MR. GILLEN:
 11 10 Q Yeah. All right.
 12 11 A I think they're both fair, but I'm not sure
 13 12 whether there were four questions.
 14 13 Q Okay. I can see that. So ahead. Tell me why
 15 14 you see them as different and answer them to the extent
 16 15 you can. I'll try and clarify.
 17 16 A Is your first question whether I think
 18 17 Paleontology bears on the introduction of Intelligent
 19 18 Design into classroom?
 20 19 Q Well, I guess what I'm asking is, I've read
 21 20 your expert report. It has this detailed and
 22 21 sophisticated analysis of the way Paleontology speaks to
 23 22 some claims that are made by proponents of Intelligent
 24 23 Design Theory, that's what they call it. I understand
 25 24 that you quote 'Intelligent Design Creationism.' That's
 25 25 one -- that's certainly the main thrust of your opinion

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 2 1 do. And I've served several times on the evaluation of
 3 2 instructional materials, textbooks and things like that
 4 3 for K-12. And I do a lot of textbook reviewing, as
 5 4 well, for, you know, just people just ask me how does
 5 this sound.
 7 6 So as an educator, I'm functioning also as a
 8 7 scientist. So the question that I'm really addressing
 9 8 is, would this be good science and would this be good
 10 9 science education.
 11 10 Q That's exactly what I was trying to get a sense
 12 11 for, just at the outset.
 13 12 When I look at your credentials and report,
 14 13 it's evident you're highly credentialed in paleontology.
 15 14 I wanted to ask you, just in terms of your training,
 16 15 have you had instruction in molecular biology?
 17 16 A Any instruction that I had in molecular
 18 17 biology, formal instruction, would have ended with my
 19 19 doctoral dissertation in the 1970s. And molecular
 20 20 biology changes so fast, that I can keep up with it with
 21 21 departmental seminars and reading. Just like everything
 22 22 else, you know, your formal instruction ends at some
 23 23 point, and then you pretty much have to keep up with
 24 24 things as best you can.
 25 25 Q Would you consider yourself an expert in
 25 molecular biology?

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 2 1 insofar as I, as a layman, can make it out.
 3 2 Then there's a series of other issues in this
 4 3 case that relate to, you know, sort of the practical
 5 4 result of the process, what actually happened. And I'm
 5 5 trying to get a sense for your expert opinion and what
 6 6 it's primarily concerned with. It seems to me, it's
 7 7 primarily concerned with the former. That is, sort of
 8 8 the intellectual discussion about the way in which
 9 9 Paleontology relates to the claims of evolutionarily
 10 10 biology, but not so much to the actual situation in the
 11 11 schools. Is that accurate?
 12 12 MR. ROTHSCHILD: Object to the
 13 13 characterization. Particularly to the extent it's
 14 14 inconsistent with the content of the expert report.
 15 15 You can answer.

16 16 THE WITNESS: I would say that I'm working at
 17 17 two levels in this report. First, as a scientist, and
 18 18 second, as an educator. I've taught at Berkeley for 25
 19 19 years. Before that, I've taught high school, sixth
 20 20 grade, seventh grade science. I -- so I suppose I've
 21 21 been teaching since -- well, well over 30 years. And
 22 22 I've worked a lot with teachers in this state on science
 23 23 education, and what the quality of that education should
 24 24 be. I was involved, as you know, with writing this 1990
 25 25 state science framework, which took really two years to

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 2 1 A No.
 3 2 Q Now about the same thing, its -- from your
 4 3 report, it's evident there's some aspects of statistics
 5 4 probability theory. What training do you have in that?
 6 5 A I'm not an expert.
 7 6 Q You mentioned that California standards for K
 7 through 12. Are there standards that speak to
 8 8 instruction in biology?
 10 9 A Could I distinguish between the standards and
 11 10 the framework those are two different -- there's -- the
 12 11 names are so confusing.
 13 12 Q Okay.
 14 13 A The framework is put together about every seven
 15 14 years. And it's a book length document that explains
 16 15 what science is, how it should be taught. It explains
 17 16 the concepts that should be laid out at all the grade
 18 17 levels, and tries to explain how they should be
 19 18 interwoven into a general picture of science.
 20 19 The State's standards are -- that's a different
 21 20 document. And those tend to be more specific in terms
 22 21 of what sorts of concepts are discussed and their
 23 22 details.
 24 23 Q Okay. If I can, I'm just going to mark a copy
 25 24 of your report as Exhibit 1.
 25 (Defendant's Exhibit 1 was

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2 marked for identification.)

3 BY MR. GILLEN:

4 Q Kevin, I'm going to show you a copy of
 5 something that's been marked as Exhibit 1, and ask you
 6 to look it over. I think you'll see it's another copy
 7 of your report, which I'm just marking for the purpose
 8 of reference in this deposition. It begins with the
 9 cover page, which is page 1, and you've mentioned the
 10 California Science Framework, K through 12. Is that the
 11 project that you were just describing?

12 A Yes.

13 Q I just want to get a sense for the difference
 14 between that framework and the standards, and how each
 15 speaks to the dispute that brings us here, which is this
 16 teaching of evolutionarily theory and biology. Can you
 17 give me just a short, if you will, overview of the way
 18 in which the California Science Framework speaks to
 19 instruction in evolutionarily biology, and particularly,
 20 whether it prohibits the teaching of Intelligent Design
 21 Theory?

22 A The framework that I worked on was the one that
 23 came out in 1990.

24 Q Okay.

25 A Intelligent Design was not on the map then. It
 26 did not specifically address Intelligent Design.

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2 A I don't believe it did directly, Pat. The --
 3 we tried to focus on what was good science and good
 4 science education. Not on what was non-science,
 5 anti-science or poor science. We tried to -- we
 6 devised, with the board of education, a statement that
 7 appeared that was very prominent. In fact, we drafted
 8 this before the framework was even written. We agreed
 9 with the board to submit a statement that explained that
 10 nothing in science, or any other field, had to be
 11 believed or accepted in order to be taught. To be
 12 educated, you had to be aware of things. But it didn't
 13 require belief in anything. And that, we hoped, would
 14 defuse some of the controversy that people felt about if
 15 I teach this in science, am I contradicting personal
 16 beliefs about things. And our statement is simply,
 17 well, you know, education doesn't compel belief, only
 18 understanding.

19 Q Let me make sure I understand you. Was the
 20 statement designed to address concerns brought to you or
 21 others involved in the part by teachers about teaching
 22 evolutionarily theory and the way it was received?

23 A That's part of it, but also, we knew very well
 24 of anti-evolution activities in the State, including
 25 creation science. People who simply didn't want
 26 evolution taught for various reasons. Largely because

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2 Q Has it been -- has a new addition of the
 3 Science Framework been --

4 A Yes. It was released a couple of years ago
 5 because these are done every seven years.

6 Q Did you play a part in that process?

7 A No.

8 Q Are you aware of whether that specifically
 9 addresses instruction in the Intelligent Design Theory
 10 or --

11 A I'm not -- I'm not aware that it does.

12 MR. ROTHSCHILD: Can I have a standing
 13 objection to the term "Intelligent Design Theory"? I
 14 think it's one that the witness probably wouldn't agree
 15 with, but I'm not going to quarrel with you using the
 16 term, is my standing objection.

17 MR. GILLEN: Certainly. Certainly, I do
 18 understand that.

19 BY MR. GILLEN:

20 Q When this was authored, Kevin, there was
 21 creationism in the air and some disputes relating to the
 22 teaching of creationism in connection with
 23 evolutionarily theory. Did your Science Framework
 24 address that issue or the issues that surround the --
 25 this clash between evolutionarily theory and
 26 creationism?

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2 I they felt it was against their religious beliefs.

3 In the State of California, you were not
 4 allowed to opt out of a class because you don't agree
 5 with what's going on. In fact, I believe in science
 6 classes, it was, and may still be, the rule that you
 7 don't have to be present for a dissection. I think
 8 that's the only thing you can be excused from.

9 Q So there is an opt-out with respect to the
 10 classes that instruct in biology?

11 A No, there's not.

12 Q There's not?

13 A Only -- I think dissection is the only
 14 exception. You can't not attend a class simply because
 15 you know it's going to be on something you disagree
 16 with, or you think you disagree with.

17 Q Okay. I'm not understanding you. Is there an
 18 exception for this instruction, this subject?

19 A No.

20 Q Okay. Okay.

21 A In other words, if you objected to a class that
 22 was going to be given on green house or earth warming,
 23 something like that, you couldn't absent yourself from
 24 class on the grounds that you didn't agree with what was
 25 going to be said.

26 Q Okay.

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 2 1 A And we wanted to -- we wanted to put in the
 3 framework what was good, accepted science, that is
 4 science accepted by the scientific community so that
 5 teachers would be able to point to it and say, look,
 6 this is what I'm supposed to teach. You know, I may not
 7 agree with you, you may not agree with it, but this is
 8 what's accepted by the scientific community and the
 9 community of science educators. So there would be
 10 support, clarity, consistency.
 11 10 Q Okay. So the statement was designed to help
 12 public education teachers deal with this culture?
 13 12 A That's right.
 14 13 Q Let me ask you about the standards. The
 15 standards that are currently enforced now, are you aware
 16 of whether they speak to the teaching of Intelligent
 17 Design Theory in class?
 18 17 A I don't remember if they do, specifically. I
 19 did not play a strong role in the drafting of the
 20 standards. And my impression is that they don't, but I
 21 haven't looked at them specifically with that in mind.
 22 21 Q What do the standards do, if you can tell me,
 23 do they layout specific objectives for each course of
 24 instruction?
 25 24 A Yes, they tend to do that.
 26 25 Q Do they do anything else? Do they give course

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1 objectives?
 2 4 A They might do. I haven't looked at the final
 3 document.
 4 4 Q Okay.
 5 5 A Well enough to tell you whether that would be a
 6 good characterization of it.
 7 7 Q Okay.
 8 8 A In all, perhaps the sum total of the curriculum
 9 that they provide does, in fact, do that by virtue of
 10 what it says.
 11 11 Q They're a public document?
 12 12 A Yes. It would be on the web. And, you know, I
 13 don't have a paper copy of it. I just tend not to sit
 14 in front of a screen all day.
 15 15 Q That's quite all right. I'm just trying to
 16 figure out how they relate in light of your earlier
 17 comment. That's all I want to see if they bear on some
 18 of the issues in this case.
 19 19 When you're -- for the California Science
 20 Framework, when you employ the term "teaching," is there
 21 any specific meaning you give that term?
 22 22 A Teaching in the sense of explaining what is in
 23 the curriculum, I suppose, would be the best. But, my
 24 gosh, there's so much more to teaching. It's
 25 understanding what students come in with, understanding

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1 how, as a group, and how individuals, they will best
 2 learn or respond to what you're trying to teach them.
 3 Trying to work with the prior knowledge of 30 different
 4 kids in class and their own behavioral and hormonal, and
 5 just personality differences. Teaching is so much more
 6 than just explaining material.
 7 7 Q Yeah. Plainly, it's an art.
 8 8 What I'm to trying to get at, though, is there
 9 a specific sort of pedagogical meaning that's attached
 10 to it like classroom instruction?
 11 11 A Well, most teaching at the K-12 level, and at
 12 the college level, is based on classroom instruction.
 13 The 45 minutes a day or the three hours a week, you have
 14 students in front of you, but teaching also occurs in
 15 office hours. With my graduate students, it's 24/7.
 16 Every time -- all the time we're in there, we're all
 17 teaching and learning from each other.
 18 18 Q Okay.
 19 19 A It gets very fluid in the upper grades.
 20 20 Q All right. Let me -- I'm just going to -- if
 21 you'll look at your report, I'm trying to understand
 22 what -- some of the details. And that's not so easy for
 23 me as a lay person, particularly one not schooled in
 24 science.
 25 25 The section B is headed paleontology as

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1 Science. And plainly, status of science is important to
 2 this case. I know very well that you have devoted your
 3 considerable talents to paleontology. And what I want
 4 to get a sense for is, plainly, you regard it as
 5 science. What makes you regard what you do, as a
 6 professional, as distinctively a scientific endeavor?
 7 7 A We collect information, facts about the life of
 8 the past. That is sort of the purview of paleontology.
 9 That life includes zoology, botany, any other subjects
 10 that happen to focus on things that are now dead and
 11 have been for a while. And our subject is that great
 12 phone book of life that's existed in the past for which
 13 we have some remains that are -- that are excavated from
 14 rock deposits in the earth. And these specimens tell us
 15 about the life of the past, how it changed through time,
 16 how it is ordered through time. The different organisms
 17 that lived at various intervals in time. How they
 18 functioned in their environments. What the patterns
 19 were by which different groups in the past waxed and
 20 waned, ultimately coming to form the bio that we have
 21 today.
 22 22 Q And I understand that. I can see that you're
 23 looking at sort of an empirical set of data facts, and
 24 you're bringing to bear principles of certain
 25 disciplines you mentioned, zoology and so on. But what

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1 I'm -- you know, for me, as someone on the outside, I'm
 2 trying to understand the distinctive features of
 3 paleontology that you believe make it scientific.
 4 MR. ROTHSCHILD: Objection to the form. You
 5 can answer.

6 THE WITNESS: The distinctive features of
 7 paleontology. Gee, they really don't differ from many
 8 other scientific fields like zoology, botany, insofar as
 9 they concentrate on a subject. In ornithology, it's
 10 birds. Of course, in botany, it's plants. In
 11 paleontology, it's -- can be both birds and plants, but
 12 it's just extinct ones.

13 And so our approach is to gather information
 14 and to form and test hypotheses about how these
 15 organisms lived in the past and how that changed through
 16 time.

17 Q And I think that last part of your answer helps
 18 me get further towards what I'm trying to grasp, which
 19 is, you say, "to form and test hypotheses." If we look
 20 at the methods of paleontology, are there certain
 21 methods that you believe make it distinctively
 22 scientific?

23 MR. ROTHSCHILD: Objection.

24 THE WITNESS: It depends on what question
 25 you're asking. Paleontology is, of course, more than

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 2 1 group of extinct animals that I work on, dinosaurs,
 3 2 horses, whatever it might be, I would use methods such
 4 3 as phylogenetic systematics, p-b-y-l-o-q-e-a-e-t-i-c,
 5 4 systematics is a-y-s-t-e-m-a-t-i-c-s.

6 5 Q Nothing like an educated witness.
 7 6 That said, what else? What other tools would
 8 7 you use, Kevin?

9 8 A If I were trying to study the functional
 10 9 morphology of an extinct animal, I would use the same
 11 10 principles of comparative anatomy and motion studies,
 12 11 for want of a better word, we call them kinematics,
 13 12 k-i-n-e-m-a-t-i-c-s, that are used by zoologists. The
 14 13 difference being that they can put their animals on
 15 14 treadmills, and they can take films of them doing what
 16 15 they do. And we basically have to work with the joints
 17 16 of the bones that are left.

18 17 Q Okay. And that is some examples. I was struck
 19 18 by this part of your -- this Section B of your report,
 20 19 which said: To ask intelligent questions and determine
 21 20 reasonable answers requires knowledge of fossils of
 22 21 comparative anatomy of ecology systematics, and so on.
 23 22 And then as I read the report, I noticed that there's --
 24 23 in several places, you say, you offer sort of reasonable
 25 24 inferences in a number of areas.

26 25 And that, Kevin, is what I'm trying to drive

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 2 1 just going out to the Badlands, finding a skull of a
 3 2 dinosaur, digging it up, and bringing it back. In that
 4 3 respect, it probably differs from botany, zoology,
 5 4 molecular biology, in that work might be done in the
 6 5 forests and the fields or the labs, more so than in
 7 6 going out to the rocks and looking for things.

8 7 That's not a question of the method of science
 9 8 or it's approach. That's simply a question of its
 10 9 material basis. It's where we find it. The molecules
 11 10 we can best get at in the lab. The plants and animals we
 12 11 can best go out to the field and collect them or see
 13 12 them or watch them. And in our case, we go out to the
 14 13 exposed rock terrains and we collect them. But it
 15 14 really depends on the kinds of questions that you're
 16 15 asking. If I'm asking questions about what are the
 17 16 relationships of fossil animals, I'm using the same
 18 17 principles that a botanist or a zoologist would use, and
 19 18 the same methods. It's just that our organisms are
 20 19 different.

21 20 BY MR. GILLETT:

22 21 Q Okay. And that's precisely what I'm trying to
 23 22 understand, which is what are -- in a case like that,
 24 23 which you posited, what are the methods that you're
 25 24 using which are similar to those of a botanist?

26 25 A If I were trying to find the relationships of a

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 2 1 at. Does your endeavor, as a Paleontologist, consist in
 3 2 just trying to do that, trying to make reasonable
 4 3 hypotheses and evaluate them against the empirical
 5 4 evidence that's available?

6 5 MR. ROTHSCHILD: Objection to the form. You
 7 6 can answer.

8 7 THE WITNESS: I would guess that's a lot of it.
 9 8 We form and test hypotheses about the relationships of
 10 9 organisms, about how they worked in their environments.
 11 10 We describe the life of the past, new things that we
 12 11 find. We look at where we lived and how they may have
 13 12 spread over various continents and oceans through time.
 14 13 We're basically reconstructing the life of the past by
 15 14 accumulating data, discerning patterns and trying to
 16 15 infer processes that account for the change of life
 17 16 through time.

18 17 BY MR. GILLETT:

19 18 Q And let me just -- I'm going to ask you a few
 20 19 things quickly and see if you can help me. I'm just
 21 20 trying to get a handle on the way in which your
 22 21 discipline works.

23 22 On page 1 of your report, you pose a question,
 24 23 what are the relationships among groups of fossil
 25 24 organisms. In your day-to-day work as a Paleontologist,
 26 25 how do you go about trying to answer that question?

Kevin Padian

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1 A We look at the preserved features of the
 2 organisms. In the case of things I work on, it would be
 3 features of the skulls and other bones of the skeleton,
 4 which are usually mostly what's left in the fossil
 5 records. And by looking at those features, we find what
 6 systematics calls synapomorphies, which is a word that's
 7 spelled s-y-n-a-p-o-n-c-r-p-h-i-e-s. It's a funny word,
 8 and it means shared derived characters. These are
 9 features that are unusual compared to other animals or
 10 plants. They are things that are novelties compared to
 11 other animals and plants. And why we look for these
 12 features follows simply from a premise about genetics.
 13 And that is, that organisms inherit characteristics
 14 from their parents, and they pass them on. And so when
 15 a new feature appears in a lineage, and it's passed on
 16 to its descendants, then we use that new feature as a
 17 mark of more recent common ancestry than with other
 18 organisms that don't have that feature.

19 It's a little confusing, but it actually
 20 results in a very interesting hierarchical pattern. If
 21 you have, for example, five organisms that you're
 22 comparing, and two of them share six features that
 23 nobody has, and the next one added to them -- shares
 24 five of those features, and the next one out shares four
 25 of them, the next one out shares three of them, and so

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1 on, ultimately, you're watching the sequence of these
 2 new shared derived characters that appear. So you have
 3 actually a hierarchical arrangement of the order in
 4 which these things would be related to each other. Does
 5 that make sense?
 6 Q Yeah. It does somewhat. I mean, it's
 7 difficult to follow, but that's what I'm trying to get
 8 at. Is there any other way in which you go about
 9 finding those relationships?

10 A No, that's --

11 Q The principle --

12 A -- that's the principle of phylogenetic
 13 systematics.

14 Q Okay. Again, in your report, you ask the
 15 question, how do mechanisms of developmental biology
 16 help us to explain morphological diversification of
 17 structures in plant and animal evolution.

18 Now, when you look at that question, Kevin,
 19 what is the method or the method you bring to bear on
 20 that question?

21 A We often look at how structures in living
 22 organisms develop. We can -- we can have a much better
 23 idea of the development of living animals than of fossil
 24 animals because embryology of fossil animals is
 25 difficult to come by, particularly early stages. They

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1 I don't preserve very well. And so, when we ask questions
 2 about, for example, which digits are these three digits
 3 of the bird's hand, or where did the bones in the middle
 4 ear of mammals come from. Sometimes by looking at the
 5 development of living animals, we can see whether
 6 fingers are lost or begin to form and then stop forming
 7 or how bones migrate from an area around the jaw into
 8 the ear. And that gives us some clue about whether that
 9 could have been the process that evolutionarily caused
 10 that change to happen.

11 Q Anything else you used to try and make that --
 12 answer that question?

13 A There are some sophisticated new techniques in
 14 developmental genetics that actually trace the
 15 expression of a gene in different structures, which then
 16 can be labeled and seem to be the same in two different
 17 organisms, even though they may appear to do different
 18 things, or their form is somewhat different.

19 Q Is that something that Paleontologist use?

20 A Paleontologists do use it. Some of them even
 21 work in developmental genetics and do this work. Many
 22 developmental geneticists also work with Paleontologists
 23 to try to solve some of these problems. One of my
 24 graduate students right now, for instance, is looking at
 25 the formation of something called the neural crest.

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1 A Neural is n-e-u-r-a-l. Crest, which is a tissue that
 2 forms early in life and it's responsible for forming
 3 many of the tissues in the body. And she's working on
 4 whether the turtle shell and the bones that are in the
 5 back of crocodiles, the kind of hard armor that
 6 crocodiles have along their backs, is actually produced
 7 by the neural crest. And to do that, she has to work in
 8 developmental genetics.

9 So, yes, I guess, I would have to say that
 10 Paleontologists are increasingly working in these and
 11 other disciplines.

12 Q You mentioned the mechanisms of developmental
 13 biology. When you use that term, what are you referring
 14 to?

15 A I'm referring to the general field that
 16 examines how specific genes influence functions of the
 17 development of structures that later become part of the
 18 adult body.

19 Q So I'm not sure, is that genetics? Are you
 20 saying it's essentially the focus on genetic change?

21 A Yes. It is how genetic change influences the
 22 formation of the structures.

23 Q Okay.

24 A In other words, morphology.

25 Q That's what I was trying to get at.

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1 When you -- do you have an opinion, as a
 2 Paleontologist, as to what that sort of that mechanism
 3 of developmental biology is that produces the genetic
 4 change?

5 A Do I have an opinion as a Paleontologist of
 6 what that is? It's -- we understand it as gene
 7 function.

8 Q Okay.

9 A But I guess maybe I don't understand the
 10 question.

11 Q When you reference the mechanism of biological
 12 change, I just want to make sure that I -- I'm looking
 13 at that term the way you do. And that's all I'm trying
 14 to understand. Is it essentially, as you say, the
 15 biological disciplines understanding of genetic change
 16 through time?

17 A Yes. It's completely consistent with that, as
 18 far as we know. We know that genes vary in populations.
 19 We know that in lineages and related species, there are
 20 different genetic constitutions. And this discipline
 21 focuses mainly on how specific genes determine specific
 22 functions that then influence these changes in form.

23 I'm sorry. I'm trying to speak as -- to
 24 explain it. I'm trying not to over simplify it, but to
 25 use words I hope --

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1 Q That's all I'm trying to do to. I appreciate
 2 any effort on your part to simplify what you do
 3 day-to-day. That's totally appreciated.

4 What I'm trying to get at here is my sense that
 5 when you refer to the mechanisms of biological change,
 6 you are -- sort of, your discipline, which strikes me as
 7 profoundly sort of interdisciplinary, is borrowing in
 8 that area from the biological sciences. And when you
 9 reference, therefore, the mechanism of biological
 10 change, you are referring to genetic change through
 11 genetic mutation, and then heredity. Is that accurate,
 12 Kevin?

13 A Yes. That's -- and you're absolutely right.
 14 We have a very interdisciplinary science.

15 Q And that's -- and then my next question then is
 16 to try and get a sense for the several places in your
 17 report where you have this -- you're taking issue with
 18 the notion of randomness. And on the one -- I'm trying
 19 to understand that. And let me see if I can tell you
 20 what I think, and then we can talk about it.

21 It seems to me that, from what you said, that
 22 genetic change is random, random mutations, but when you
 23 get to selection, it seems that you have a very definite
 24 conviction, as a Paleontologist and a scientist, that
 25 that selection is not random. I want to see if I'm

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1 apprehending your position correctly and then just have
 2 you explain it to me a little more. Is that accurate,
 3 Kevin?

4 A I'm sorry, no.

5 Q Okay. Tell me why.

6 A Selection is the opposite of random.

7 Q And I do understand that.

8 A Okay. So that if we had random admission to
 9 university, it would be very different than if we
 10 selected people on the basis of various features that --
 11 and --

12 Q But -- excuse me, because I don't want to waste
 13 your time, or anyone's time here. We have the genetic
 14 changes, right?

15 A Yes.

16 Q And then it seems that, based on your report,
 17 if I'm understanding it, then there's a selection
 18 process. I'm just focusing right now on that genetic
 19 change. And I'm -- it seems to me, based on your
 20 report, that when you're describing that facet of the
 21 mechanism of biological change, that is random; is that
 22 correct?

23 A Let me explain it slightly differently. When
 24 we say something is random, it's a probabilistic
 25 statement about -- about the distribution of certain

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1 cases in a population. It does not mean that the causes
 2 are random. We may understand very well what the causes
 3 are of some kind of a change. We may still not know
 4 which individuals in a population would be affected in
 5 advance of this actually happening.

6 I believe I used an analogy to -- I'm not sure
 7 if I did in this report. I'm sorry, Pat. Let me give
 8 you an analogy. We may say that 350 house fires occur
 9 in California each year. If -- and we know why they're
 10 caused, arson, smoking in bed, lava lamps fall over,
 11 whatever. We have a good idea that maybe that pattern
 12 has been 350, roughly, for a long time, where it's a
 13 rate of 350 in the population, you know, maybe grows
 14 with the population rate, that's fine. But we don't
 15 know in advance which houses are going to burn. If we
 16 did, we wouldn't need insurance. And when we talk about
 17 random effectively, we could say, well, house fires --
 18 or the instance of house fires is random, but it's not
 19 in that case because we know that they each have a
 20 cause. They just don't happen. It's just that we can't
 21 predict which ones will be there in advance.

22 Now, let's say we have a simple genetic
 23 mutation of white-eye in a fruit fly or something.
 24 Just -- not very important thing, just a little -- and
 25 that on the average, may be about six in 100,000 might

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1 have this white-eye difference. We might or might not,
 2 and I don't know fly genetics enough to tell you, we
 3 might or might not know the gene function that produces
 4 that white-eye. We may know which gene does it, even if
 5 we don't know what the function is. But we know that
 6 that change itself is not random. We simply know that
 7 the -- which particular individuals in the population
 8 will have it, is random. And if we have a rate of six
 9 in 100,000, we may have eight one year and three the
 10 next generation. But that's the meaning of random to a
 11 scientist, as I understand it.

12 Q And I understand that, and thank you. I'm just
 13 trying to get a sense for -- let's keep with the fruit
 14 fly. The first instance of the gene that produced the
 15 white-eye. If we look at the mechanism for that change,
 16 is that random mutation or do we have some other
 17 understanding of how the biological sciences address
 18 that initial mutation that produces a change in a given
 19 species, in this case, the white-eye in the fruit fly?

20 A It's a change, but I don't think it would be
 21 correctly characterized as random. We know that a
 22 duck's head isn't going to pop up on a horse or a trout.
 23 So in a sense of anything can happen, that's not our
 24 understanding of random. And when, you know, your kids
 25 come in and say, oh, like that's so random. They

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1 don't -- they're talking about it like it came from
 2 nowhere. Somebody just seemed to say something that was
 3 a non sequitur. And so our common understanding of
 4 words like random are real different from what we mean
 5 in science. And my understanding of random, as a
 6 scientist, would not apply to causal factors, but rather
 7 to distributional factors in populations.

8 Q Okay.

9 A For example.

10 Q Okay. Then just let me understand here if I
 11 can. Are you saying that there's no such thing as a
 12 random genetic mutation?

13 A When applied to causality, I would say I don't
 14 understand how the word "random" is interesting or
 15 applicable there.

16 Q And by that --

17 A Although we talk about it all the time, don't
 18 we? And what I think we mean is the incidents in
 19 populations.

20 Q So again, just to make sure I understand you,
 21 is it your view that any genetic change is not random?

22 A I would agree with you in the sense that it is
 23 all determined by biochemical causes, genetic causes,
 24 things that get down to the genetics -- that determines
 25 structure.

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1 Q Okay. So then when you look at -- you say --
 2 when you say natural selection is the opposite of
 3 randomness, explain then, what, to me, please, so I can
 4 understand you, what are you getting at there, what
 5 is -- why is natural selection not random, in your
 6 opinion?

7 A If you have a population of organisms, they
 8 might be -- they might be nice, let's say, living out in
 9 the field somewhere. Darwin's idea was that some
 10 organisms, some individuals, would be more fit than
 11 other individuals. And that the ones who would be
 12 better able to live in their environments escape from
 13 predators and so forth, make more efficient use of food
 14 resources, and so forth, would be the ones more likely
 15 to survive to the next generation. And to survive
 16 perhaps longer to produce more offspring so that those
 17 same features that this organism had would be passed on
 18 to the next generation. That's his idea of selection.

19 Random would be those same mice living in a
 20 field and a tree falls and kills 50 of them. And the 50
 21 that it kills are -- have no real fitness component
 22 about them. In other words, it's taking everybody
 23 regardless.

24 When the plane crashes, it doesn't matter
 25 whether you're a -- you know, the Pope or the president

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1 or, you know, just some normal dumb guy like me. It
 2 just -- that's what happens when you happen to be on
 3 that plane when this happens. So that would be
 4 non-selective. That would be sort of a random calling
 5 of the population in that sense, because it wouldn't be
 6 correlated with any selective factors that have to do
 7 with the organisms themselves. Rather, they were
 8 unlucky.

9 Q So am I understanding you correctly that,
 10 essentially, you believe natural selection is not random
 11 because it's positing a causal connection between the
 12 attributes of the given species and its ability to
 13 survive?

14 A Just so.

15 Q Now, but that just -- and in positing that
 16 relationship, you're -- it entails positing both an
 17 advantage or feature of a species and then a way in
 18 which it would confer an advantage on the members of
 19 that species with that characteristic; is that true?

20 A That's the idea.

21 Q Okay. And is that why, Kevin, in your report
 22 at several points, you make this very clear, selection
 23 is the opposite of random. Is that what you're getting
 24 at there?

25 A Yes.

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1 Q Just so I can understand it, it's a notion that
 2 there's a causal connection between the feature and
 3 survivability as opposed to, as you say, the tree falls.
 4 It had nothing to do with who or what you were and what
 5 your attributes were, it's just bad luck?

6 A That would be the idea.

7 MR. ROTHSCHILD: This is a good time for a
 8 break?

9 MR. GILLEN: Yeah, it is.

10 (Recess.)

11 BY MR. GILLEN:

12 Q Kevin, this is -- all the questions I've asked
 13 you so far, I'm trying to just make sure I understand
 14 this process as you do, which -- just in its rudiment.
 15 What I'm looking at is the statement like this at the
 16 bottom of page 2 of your report that carries over.
 17 You're talking about Darwin's view, and you say, he was
 18 not talking about how major new adaptive changes took
 19 place; he was talking about how minor variations could
 20 be selected upon by natural forces to produce heritable
 21 evolutionary change.

22 And there's a couple of elements to that
 23 sentence that have to be impacted to a layman like
 24 myself. The first is the minor variations in the
 25 species. Am I correct in that when you, as a

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1 Q Paleontologist, look to those minor variations in the
 2 species, you account for them with reference to biology,
 3 more specifically genetics?

4 A When we see variation in a population of
 5 organisms, whether it's living or fossil, there are two
 6 basic causes of that variation. One is genetic, and one
 7 is environmental.

8 Q Okay.

9 A So a stunted population of trees might be
 10 stunted not because their genes make them short, but
 11 because their environment is harsh and it's tough to
 12 grow.

13 Q Okay. And if -- so of those two possibilities
 14 for the minor variations, we have one that's genetics or
 15 internal, and then there's another that's external to
 16 the subject, the specimens; is that accurate?

17 A Yes. One is heritable, and the other one
 18 isn't.

19 Q Okay. And for the purposes of -- well,
 20 Darwin's theory, we're looking at the heritable?

21 A Yes.

22 Q Now, selected upon by natural forces. I think
 23 you gave me some good examples of that earlier. That's
 24 in ways in which the surrounding environmental factors
 25 give rise to a causal relationship between the features

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1 of the species and the environment which confers an
 2 evolutionarily advantage on the species with a specific
 3 trait; is that accurate?

4 A Yes, more or less. Some individuals are going

5 to be more favored than others.

6 Q All right. And then produce heritable
 7 evolutionarily change. Just to make sure I understand
 8 what you're getting at there. It's that notion
 9 therefore, because of these -- this advantage, it's more
 10 likely that species with the advantage or members of the
 11 species with the advantage will pass it on in the
 12 genetic matter of their offspring?

13 A That was Darwin's idea.

14 Q Okay. Now, then you say, when you go on, you
 15 say his main concern, Darwin said this, was with the
 16 mechanism of natural selection, which cannot be observed
 17 directly in the fossil record. Now, I wanted to make
 18 sure I understand that. Again, the mechanism of natural
 19 selection. Is this the relationship between the feature
 20 and the environment or is it the genetics or a
 21 biological component of the process?

22 A It's the process by which the composition of a
 23 population changes from one generation to the next based
 24 on factors that make it more fit for its environment.
 25 That would be selection in that sense.

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1 And when I say that we can't observe this in
 2 the fossil record, what I mean is that we can't observe
 3 generation-by-generation full populations, we can't take
 4 their genetic constitution. We don't have a complete
 5 enough sample. So when we look at the action of
 6 selection itself on a generation-by-generation basis,
 7 that's much better than done in field and laboratory
 8 studies today. And a lot of that work has been done.

9 Q That's what I was trying to understand. You're
 10 getting at there that the fossil record, as it exists
 11 today, is insufficient to wholly grasp this process
 12 you've described. Is that your point?

13 A It's insufficient to measure the
 14 generation-by-generation selective factors. What it
 15 does measure, is the overall effect of selection on
 16 populations through time, which -- one of which we call
 17 adaptation. And so, we actually identify the action of
 18 natural selection through the proxy of watching -- of
 19 watching adaptations evolve in lineages through time.

20 In evolutionarily theory, adaptation is defined
 21 as the result of natural selection. These are features
 22 that are improved behaviors, functions that are improved
 23 through the action of natural selection, which is again
 24 this rubric, r-u-b-r-i-c, that encompasses environmental
 25 factors, factors of competition, predation, interactions

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 2 1 With other organisms to shape succeeding generations.
 3 2 And there's also an element of opportunity,
 4 3 that is, organisms often change evolutionarily because
 5 4 they're able to make use of a new feature in their
 6 5 environment that wasn't exploited before, and a lot of
 7 6 that is what we see. So when we look at the adaptive
 8 7 improvement of structures in a lineage through time,
 9 8 we're -- we are making the inference that selection has
 10 9 done this. But the generation-by-generation measures of
 11 10 selection are done in populations of animals in which,
 12 11 for example, we're watching much more small scale
 13 12 adaptations, not the ones that takes millions of years.
 14 13 Q Okay. Let me make sure I'm following you here,
 15 14 to the extent I can. First, it seems, based on your
 16 15 answer, that when you say you're looking at the
 17 16 mechanism of natural selection, we're sort of -- it's
 18 17 prescinding from paleontology trying to locate or prove
 19 18 out this sort of genetic component of the process,
 20 19 that's kind of taken off the table; is that accurate?
 21 20 A We can't examine the genetics of the fossil
 22 21 populations in that same realm, which is right.
 23 22 Q Then you say, you observe a population through
 24 23 time. I think you said using adaptation as a proxy --
 25 24 A Yes.
 26 25 Q -- for selection?

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1 90050
 2 1 Now, if I may, Kevin, are you saying there that
 3 2 if a feature persists through time, you infer that it
 4 3 has conferred an advantage, that it's been selected, so
 5 4 to speak, or --
 6 5 A I'm more talking about cases in which we see
 7 6 the emergence of a feature that has a demonstrable
 8 7 functional behavioral role. If this is -- if this is
 9 8 persisting, and even improving or elaborating through
 10 9 time, then we presume that there is some sort of
 11 10 selective role. There's some sort of advantage to this
 12 11 feature. And that, as we say in our common parlance,
 13 12 selection is maintaining or shaping that feature.
 14 13 Q So the underlying inference is that adaptation
 15 14 which persists confers advantages, are a positive
 16 15 addition to the species?
 17 16 A Yes.
 18 17 Q At the end of the section D, you have a
 19 18 sentence that says, "The fossil record provides strong
 20 19 support for evolution, and has since the mid-1800s."
 21 20 Is it proof along the lines that you've
 22 21 suggested thus far this morning, Kevin, this notion that
 23 22 you can watch a pattern of certain adaptations and
 24 23 endurance through time on the part of certain species,
 25 24 is that the evidence.
 26 25 A Both those things and more.

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 2 1 Q Okay.
 3 2 A People in the early 1800s, and even slightly
 4 3 before then, recognized that the fossil organisms that
 5 4 they found in rocks were not uniform from place to place
 6 5 and from -- as you went up a rock column either in one
 7 6 place or stacking them by correlating them from one
 8 7 place to the next, because they are the same things over
 9 8 here and then there's more beds below them, and they can
 10 9 be inferred to be below the ones that were over here and
 11 10 so on. Those -- those fossils, the farther down you
 12 11 went, the less they resembled the organisms of today.
 13 12 Some of them had no present day counterparts at all.
 14 13 Some of them were enormously successful like trilobites
 15 14 in rocks that are very, very low in the available
 16 15 section, which people came to realize were very, very
 17 16 old.
 18 17 And so, we see these patterns of waxing and
 19 18 waning of replacement of some groups by others as -- as
 20 19 the whole support for what used to be called the
 21 20 progression of life through time. That progression
 22 21 could be explained by any number of ideas. The idea
 23 22 that in the early to mid-1800s was given to support it
 24 23 was evolution. That is, that things were changing
 25 24 through time. And some things were disappearing, and
 26 25 some things were forming anew. And that these often

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 2 1 resembled things that were already in the preceding
 3 2 sediments. So the whole idea of biological evolution
 4 3 was actually well in the year before Darwin wrote a
 5 4 word.
 6 5 Q Okay. On page 10, Kevin, where you discuss
 7 6 about Pandas and paleontology, there's a line in here
 8 7 that I just want to make sure I understand. It's the
 9 8 second full paragraph under subheading G, and it's about
 10 9 halfway down the paragraph. And it reads, "The origin
 11 10 of major new adaptive types and major groups of
 12 11 organisms begins with a single speciation event of very
 13 12 few minor structural changes."
 14 13 Now, it seems to me, from our discussion this
 15 14 morning, the speciation event is the province of the
 16 15 genetic facet of the process; is that correct?
 17 16 A No.
 18 17 Q Okay.
 19 18 A Recognizing different species is not solely a
 20 19 matter of genetic difference.
 21 20 Q Well, what accounts for this?
 22 21 A We actually recognize species by different
 23 22 criteria. What we call a species is a lineage that is
 24 23 distinct from other lineages in essentially time and
 25 24 space. How do we know these things are distinct in time
 26 25 and space? We have a series of criteria. For organisms

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1 that interbreed with each other, we find that if they
2 can no longer interbreed with each other, then they are
3 separate lineages or species.

4 Sometimes organisms could potentially
5 interbreed with each other, but they live in -- they've
6 wandered off into different places. And so effectively,
7 they're not going to do that any more.

8 Sometimes they may live in close proximity, but
9 ecologically, they're doing different things, so they
10 don't encounter each other so often. And there are
11 other ways that people look at this. So the formation
12 of species themselves is a process that goes beyond
13 simply a genetic assessment to an assessment of how the
14 organisms live in the world.

15 Q So am I correct that there's -- your answer
16 points to two possible sources for a speciation event?
17 One is genetic. The other is environmental in the ways
18 that you described in that the populations can be so
19 distributed that they're no longer going to be
20 considered as one species. Is that accurate, Kevin?

21 A The words you started with, it can be both
22 genetic and other means. Again, I think that our
23 characterization is one of lineages that are separate.
24 They may have genetic differences. Certainly, they
25 probably will to a greater or lesser degree. Sometimes

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1 acquire their way from the flatlands up onto the
2 hillside where things are a bit -- life is a bit
3 tougher, let's say. There's a shorter warm season, the
4 winds may be more severe, the soil may not be as good.
5 And yet, these populations are adapted to live up there,
6 they're happy, they're doing fine.

7 Ultimately, they may become so genetically
8 different from the ones down on the flats, but even if
9 you transplant them, A, they won't do well. And if you
10 try to interbreed them, then don't interbreed with
11 fertile offspring. That's the classic model of the
12 species difference that we would call adaptation.

13 Q That's a genetic?

14 A It eventually acquires a genetic component to
15 it.

16 Q Through the selection due to the environmental
17 factors?

18 A Yes. Selecting on particular genotypes through
19 selecting the phenotype that are more adapted to this
20 new environment. That's the classic mode of speciation
21 that people think about.

22 Q Then again -- I'm just -- on page 10 here, you
23 say, 'A speciation event of very few minor structural
24 changes.'

25 Now, there, Kevin, are you referencing -- are

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1 they have very few. But it mainly is a question of, are
2 they separate from each other, do they prefer organisms
3 that interbreed, do they interbreed with each other.

4 For example, we have a concept called sibling
5 species. And sibling species are those that you can't
6 even recognize if you just put two individuals on the
7 table. Two beetles, for example. You may not be able
8 to tell their difference at all, or two crickets. And
9 they tell their difference because they have different
10 mating calls. Or -- so, for example, the two crickets
11 may live on the same Hawaiian island right next to each
12 other. But the one will have a mating call that its
13 females will recognize, but the other females won't.

14 The two beetles may be perfectly alike, except
15 one will breed two weeks after the other. So they will
16 actually never come into contact again, but they still
17 look the same. These are, for all intents and purposes,
18 separate species, lineages through time that are now no
19 longer the same thing.

20 Q Well, what accounts for that kind of event,
21 that speciation, I guess you call it?

22 A Speciation. What accounts for it? Well, some
23 speciation probably has an adaptive basis. That is,
24 let's say you have several populations of a plant and
25 those plants are distributed and some of them eventually

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1 you referencing in this sentence, 'The origin of new
2 major adaptive types and major groups of organisms
3 begins with a single speciation event of very few minor
4 structural changes.'

5 Is that a reference to genetic changes in the
6 subject species?

7 A Well, it has a genetic component. But I think
8 maybe we should focus on what we call the phenotype,
9 which is the appearance of the organism and it's
10 behavior and function. This is where the rubber meets
11 the road evolutionarily. You can throw a lot of
12 organisms out in the world with different genetic
13 components. Who survives, in terms of when selection is
14 acting, determines -- is determined by the whole
15 phenotype and not an individual gene, in most cases.
16 The genes will determine the phenotype. The genes will
17 determine the phenotype.

18 So it's probably better to focus on what sorts
19 of phenotypic differences in form we can relate to.
20 Because, as we've established, we're not doing genetic
21 studies on long extinct organisms. We have their --
22 what's left of their appearances, their form, their
23 phenotypes to work with.

24 So it's these few structural changes that
25 people in evolutionarily biology who look at life on the

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 2 1 long run, can work with to sort of see where big
 3 2 elaborate adaptation start, which is frequently from
 4 3 just a few structure changes.
 5 4 Q That's what I'm trying to get. I'm trying to
 6 understand here. You described this process, these
 7 changes accumulate. Now, I'm -- what are you getting at
 8 there? The small structural changes tend to accumulate?
 9 Give me an example of that, if you would, so I can try
 10 and follow you.
 11 A I'm trying to explain that when we have
 12 sequences of major adaptive change in evolution, the
 13 kinds of adaptive change that often separate whole great
 14 groups of organisms, mammals from their closest
 15 non-mammal relatives, birds from reptiles, how do we get
 16 across these gulfs? Is it all a sudden change and boom
 17 there's a full-fledged bird? No, that's not the
 18 pattern. The pattern repeatedly, as we come to have
 19 more fossils available to us and better means of
 20 analyzing them, more complete interdisciplinary ways of
 21 looking at these questions, we're actually finding that
 22 these great gulfs that seem to separate living groups
 23 like that in a fossil record, we actually find features
 24 that close the gap much more than we could expect. And
 25 often in ways that we didn't predict.

Q And you use the term "features." And it seems

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 2 1 to me, from reviewing your report, that you
 3 2 differentiate transitional features from transitional
 4 3 forms.
 5 4 A That's a very good distinction. I'm really
 6 glad that you got that. Because that's a very important
 7 point that is lost on a lot of people.
 8 Q And plainly, that's one of the issues here.
 9 I'm just trying to understand. It seems from what you
 10 said earlier, that if you watch a feature persist
 11 through time, you're regarding that as an adaptation?
 12 A We regard it as an adaptation if we can
 13 identify some functional or behavioral utility. We can
 14 see it as an adaptation if we see it improve or change.
 15 For example, from something where there doesn't seem to
 16 be a specific function to acquiring this new function.
 17 In other words, we can look at the -- we can
 18 look at the forelimb of the animals that eventually
 19 became whales, the earliest whales. And we identify
 20 them as whales, even though they're animals that are
 21 walking around on land like horses and cows, although
 22 they don't look like horses and cows. On the basis of
 23 features of their skulls and teeth that align them with
 24 later whales. In other words, these are basic
 25 synapomorphies of whales. As these early whales begin
 26 to go into the water more, which I can explain the whole

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 2 1 detail. But as they go into the water more and stay in
 3 2 the water more, these limbs on the forelimbs, the hands
 4 3 become longer and more like flippers. Where as the hind
 5 4 limbs become much smaller and finally are unable to
 6 5 support the animal on land. These we would see as a
 7 6 change in these features through the lineage of whales
 8 7 that we would regard as an adaptation, because we know
 9 8 from functional morphology that a flipper-shaped fin is
 10 9 good for swimming.
 11 10 Q Gotcha. Now, in that same sort of adaptation
 12 11 in another beast would not contribute to its ability to
 13 12 survive in its environment; and therefore, you would not
 14 13 regard it as an adaptation?
 15 14 A We wouldn't see it on a horse.
 16 15 Q Now, with transitional features, are you -- is
 17 16 your point there that you see the features in a number
 18 17 of different lines as opposed to -- in other words,
 19 18 what's the distinction between the transitional feature
 20 19 and the transitional form?
 21 20 A That's a good question. The transitional
 22 21 features are seen in the lineage of organisms. Not ones
 23 22 that are completely unrelated to each other, but ones
 24 23 that are related to each other. And we watch these
 25 24 features changing in this lineage. The lineage of
 26 25 animals we find, let's say, we don't have to find a

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 2 1 specific linear ancestor. It may be an uncle off the
 3 2 path here, but he may share these synapomorphies with
 4 3 all the later whales. And so, he'll tell us a lot about
 5 4 what the quote/unquote direct ancestors, which we may or
 6 5 may not find, actually were like.
 7 6 Q So, Kevin, just so I understand, with -- when
 8 7 you make these judgments involving that funny word of
 9 8 shared features, how are you doing that as a
 10 9 Paleontologist, what criteria are you using to place
 11 10 some particular specimen or -- in a given family or
 12 11 line?
 13 12 A Right. We're using the synapomorphies from all
 14 13 parts of the available material. By which, I mean the
 15 14 skull and the skeleton, all the bones that are available
 16 15 to us. For example, when I was talking before about the
 17 16 forelimb changing, we wouldn't just line up forelimbs in
 18 17 a sequence and say, that must be the way they evolved.
 19 18 We would have to look at all the characters of the
 20 19 skull, the teeth, the vertebrae, the ribs, the pelvic
 21 20 girdle, the hip, the hind limb, the feet, the tail.
 22 21 We'd actually -- we say code, and we mean specify the
 23 22 conditica of those features, describe those features,
 24 23 and put descriptions, coded descriptions, of every one
 25 24 of those features into a big data matrix. And then we
 26 25 essentially ask the computer to sort out which things

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1 share the most synapomorphies.
 2 In fact, if we're asking questions about the
 3 forelimb, we might even take all the forelimb data out
 4 of that matrix and just run it on the other things,
 5 okay, so that we have our answer; we have an answer that
 6 describes for us who is sharing the most synapomorphies
 7 in this group. How are these things branching off with
 8 each other and from each other? And then, we can, if we
 9 like, ask the question, well, what does that tell us
 10 about the changes in the forelimb through time? Are we
 11 seeing a single change from the simple standing leg to a
 12 big flipper or is the pattern somehow different? And
 13 the idea that -- the idea is that we test ideas about,
 14 for example, forelimb evolution, by comparing them to
 15 the distribution of differences in all of the features
 16 of those organisms. Does that help?

17 Q if not, it's not for lack of trying. Let me
 18 just try and understand.

19 A Sorry. It's really abstract.

20 Q In terms of the process you described, and if
 21 we take the whale as an example, if I look at the way
 22 this classification is looking for shared transitional
 23 features and so on, works, is it -- do I understand you
 24 correctly, you measure, sort of quantify and classify
 25 the individual parts or attributes of the subject of

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1 your examination, and then you compare those. You've
 2 got classifications that are set out for each of these,
 3 the forelimb and other, the skull, the teeth and other
 4 parts, you load all the data, as you say, and then,
 5 based on a doubtless complicated sorting process, try
 6 and see the greatest overlap of features, which, in
 7 turn, points to the most likely lineage for that
 8 particular subject?

9 A That's basically it.

10 Q Okay. So the -- in that case, I guess, there's
 11 sort of reason judgement that's being made based on sort
 12 of the weight, the center of gravity, or the
 13 preponderance of what appear to be shared features. Is
 14 that accurate?

15 A The presumption is that the more shared new
 16 features that organisms have, the more recent their
 17 common ancestors have been. If two organisms share 46
 18 of these things and they only shared two with somebody
 19 else down there, then they're presumed to be more
 20 closely related as an extreme example.

21 Q Sure. When you say "more closely related,"
 22 there's obviously -- we focused on the feature
 23 comparison component of that analysis. Are there other
 24 components that you use?

25 A In living animals, increasingly. Analysis of

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1 the genetic material itself is used. So the DNA/RNA
 2 segments can actually be looked at. Specific genes can
 3 be sequenced. The specific parts of the gene can be
 4 looked at. And these comparisons, again looking for
 5 shared derived features of the gene, provide a
 6 tremendous wealth of information far beyond what we can
 7 get from the skeletal parts, because there are simply so
 8 many genes.

9 Q Okay. But then, again, you've got this
 10 fascinating portion of your report here dealing with the
 11 whales and whether they could have an aquatic or
 12 terrestrial ancestor. And the point of that, if I'm not
 13 correct, is that the molecular biology has its limits,
 14 also, in positing these lineages. It simply can't -- at
 15 least, if I'm understanding it correctly, it can point
 16 to a certain shared ancestry, but it cannot really
 17 pinpoint certain features of that shared ancestor at
 18 all?

19 A To the extent that genetic analysis is not
 20 possible for completely extinct animals, that's true.
 21 So for example, in the whale -- in the case of the
 22 whale, the most recent molecular analyses were telling
 23 us that whales and hippos are each other's closest
 24 relatives, which is really hard to believe for many
 25 people. Simply because they are so different. But of

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1 course, whales are different from everybody now. But if
 2 you go back 50 million years to the Eocene, they weren't
 3 that different from other kinds of hoofed animals
 4 running around, which also didn't look like hippos of
 5 today.

6 Hippos are only found in the fossil record for
 7 maybe 15 million years. Whales are first known over 50
 8 million years ago. So we've got a 35 million year gap,
 9 where are the hippos. And it turns out that only
 10 fossils can tell us that hippos are members of a larger
 11 extinct fossil group. I won't bore you with the name.
 12 And that these guys are related to the early whales.
 13 But there's no trace of them in the living fauna. So
 14 molecular analysis couldn't assess them.

15 Q It cannot go back. As you say, you just don't
 16 have the genetic material needed to plumb that line?

17 A On the other hand, molecular analysis is
 18 correctly giving us two things. One, is the fact that
 19 hippos and whales are each other's closest living
 20 relatives, which is great. And the other thing is, that
 21 the degree of their divergents, the degree of their
 22 molecular genetic differences implies that they diverged
 23 from each other maybe 50 million years ago, which is
 24 about what we would calibrate from the fossil record
 25 just because they're genetically so different. So it

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2 1 really is telling us a lot of this.
 3 2 Q In terms of the inference you can make from
 4 that?
 5 4 A Yes. It's consistent, in other words.
 6 5 Q And in terms of the role that paleontology
 7 played in making this judgement as to whether or not the
 8 original shared ancestor of the whale and the hippo was
 9 terrestrial or aquatic, am I correct that that judgment,
 10 in turn, rests on this process you described of tracing
 11 out the lineages based on shared features?
 12 A Yes.
 13 12 Q Let me ask you again, trying to understand the
 14 basis for your opinion here. At a couple points in your
 15 report on page 2, for example, you point out that Darwin
 16 was not -- let me see if I can find this. He wasn't
 17 principally concerned with new major adaptive types,
 18 that wasn't -- and you say that, I think, on page 2 and
 19 3 and then later on page 10; is that correct?
 20 A Yes.
 21 20 Q Now, on the other hand, on page 5 of the
 22 report, when you're dealing with Intelligent Design
 23 Theory, or IDC as you call it, you're -- you dismiss the
 24 distinction that they make between macro and
 25 microevolution. What I'm trying to get at there, Kevin,
 26 is what -- on the one hand you seem to be recognizing

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 2 1 that there's a distinction. And on the other, you're
 3 2 plainly somewhat disapproving of this component of
 4 Intelligent Design Theory. What are you getting at
 5 there, what is your ...
 6 A IDC supposes that the kinds of changes that
 7 separate major groups of organisms are not tractable to
 8 evolutionary solutions. And so they posit that in
 9 these cases, there must be some other causal agent about
 10 which we know nothing, but it has an intelligence. And
 11 I think that scientists would characterize
 12 macroevolution not as huge changes, but rather as
 13 changes that occur in groups once you reach the level of
 14 species.
 15 In other words, individual in a population is
 16 microevolution, changing from generation-to-generation.
 17 Once you get separate species, and you're talking about
 18 how those lineages behave through time, you're talking
 19 about macroevolution. And an example might be, let's
 20 say we have some horned animals, and that one group
 21 looks like the Impalas, and they have fairly simple
 22 lightly curved horns. This lineage, going back in the
 23 fossil record, seems to be pretty much Impalas all the
 24 way. Back 10, 15 million years in Africa, they look
 25 pretty much like Impalas. That lineage is related to
 26 another lineage that includes the Wildebeest, the

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2 1 Kudu, Springbok, things like that. There's a lot
 3 of them, and they have a lot of funny names. But they
 4 have a great diversity of horn shape. And they have
 5 been a much more successful group than the Impalas in
 6 terms of species diversity through time.
 7 6 Macroevolution might ask the question, why
 8 should that be, what is contributing to the success of
 9 one over the success of the other, are they better at
 10 running, are they better at feeding, do they have better
 11 ruminant stomachs, or is it just that this head gear
 12 enables them to make more species because they recognize
 13 differences and form new lineages.
 14 13 These are the kinds of questions that you can't
 15 ask by looking at individuals in populations. And
 16 there's nothing magical about it. We're still dealing
 17 with individuals who are changing and passing on their
 18 genes. But the phenomena are a little bit more large
 19 scale. And I kind of think about it a lot like
 20 economics. We have microeconomics and macroeconomics.
 21 21 Q What -- let me ask you, is it -- it's not so
 22 much, in my understanding here, it's not so much the
 23 distinction between macroevolution and microevolution,
 24 it seems like that, in your opinion, there is a basis
 25 for that distinction; is that accurate?
 26 A There is a distinction in the hierarchical

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 2 1 level in which we're studying things.
 3 2 Q Okay. One within the species, that's
 4 microevolution, and the other, macroevolution, would be
 5 changed between species.
 6 5 Now, Kevin, is that what you refer to as a
 7 speciation event, those -- or the result of a speciation
 8 event?
 9 A We would say that macroevolution is the
 10 9 interactions among species. We have to begin the
 11 10 discussion of macroevolution with the speciation event
 12 11 because that's what produces new species, as opposed to
 13 12 below the speciation level. We're talking about
 14 13 individuals in populations.
 15 14 Q Let me ask you, when do you -- how do you make
 16 15 the judgement that's there's been a speciation event?
 17 16 A When we recognize two organisms as separate
 18 17 species, which we do according to the criteria we
 19 18 discussed before.
 20 19 Q So that's the interbreeding criteria, there's
 21 20 no longer interbreeding?
 22 21 A That's one criteria, yes.
 23 22 Q What were the other, there was nonrecognition,
 24 23 sort of?
 25 24 A Exactly. There's ecological differences,
 26 25 geographical differences, sure.

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2 1 Q Okay. So am I correct then, that the objection
 3 2 here you have here on page 5 of your report, used --
 4 3 related to the use of the terms "macroevolution" and
 5 4 "microevolution" by the proponents of Intelligent Design
 6 5 Theory, is based on what you said earlier, that in your
 7 6 judgment, Intelligent Design Theorists see
 8 7 macroevolution as intractable, as you put it, to
 9 8 evolutionarily solutions?

10 9 A Because they see it as an entirely different
 11 10 kind of process that creates big changes. That is not
 12 11 the definition of macroevolution that scientists use.

13 12 Q Okay. What is the definition of
 14 13 macroevolution, just so I have it down?

15 14 A I would define it as the study of patterns and
 16 15 processes in lineages of organisms above the species
 17 16 level.

18 17 Q So -- and that is, I think, what you're
 19 18 referring to in several portions of your report where
 20 19 you say how new major adaptive types emerge?

21 20 A Yes.

22 21 Q That's the subject of macroevolution?

23 22 A That's one of them, sure. Mass extinctions
 24 23 might be another.

25 24 Q Okay.

26 25 A And there are many other kinds of subjects,

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2 1 this level of macroevolution is really just a sort of a
 3 2 quantitative accumulation of microevolution?
 4 3 A In many respects, yes. And I also -- and
 5 4 without contradicting that statement. What I want to
 6 5 say is that macroevolution studies a different
 7 6 hierarchical level of phenomena than microevolution
 8 7 does, microevolution being concentrated on the
 9 8 population level changes, and macroevolution being
 10 9 concentrated on higher levels of related groups and
 11 10 their environments through time.

12 11 Q And just again, this is kind of simple, but
 13 12 forgive me, I'm trying to follow you here. When you say
 14 13 that paleontology is providing support for
 15 14 evolutionarily theory, that's what you're getting at, is
 16 15 this observable pattern that you found here in the
 17 16 fossil record, in your opinion, demonstrates the result
 18 17 of the process of biological change in natural
 19 18 selection?

20 19 A That's a big part of it, yes.

21 20 Q What are the other parts?

22 21 A Well, the other elements of macroevolution that
 23 22 we haven't talked about include things like that, the
 24 23 documentation of mass extinctions. That's a big subject
 25 24 in evolutionarily theory that can only be assessed by
 26 25 macroevolution. It doesn't apply, of course, in any

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2 1 biogeographical change. For example, how marsupials got
 3 2 from North America to Australia and South America.
 4 3 Through time, these are important questions --

5 4 Q Okay.

6 5 A -- that we ask, yeah.

7 6 Q Again, those are either genetic or
 8 7 environmental?

9 8 A Functional.

10 9 Q Functional changes. I'm sorry, Kevin.

11 10 That account for a speciation event; is that
 12 11 correct?

13 12 A I wouldn't say they account for speciation
 14 13 events. They presuppose that species exist and they're
 15 14 often concerned with the patterns of how these species
 16 15 are deployed in space and time, the processes by which
 17 16 they get there or survive, and the mechanics of
 18 17 organisms that allow them to make a living and survive
 19 18 in their various environments.

20 19 Q And is your principal difference with the
 21 20 IDT -- short for Intelligent Design Theory, from here on
 22 21 out -- is that they don't -- they don't see that
 23 22 macroevolution as being accountable for by
 24 23 evolutionarily theory?

25 24 A Yes.

26 25 Q Where as, it seems your opinion is that the --

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2 1 way, to the population level.

3 2 When you find a point in time where there is a
 4 3 substantial proportion of living organisms becoming
 5 4 extinct in a relatively short time, we identify those as
 6 5 mass extinctions statistically, actually, by virtue of
 7 6 what a big excursion it is from normal extinction rates.
 8 7 The study of mass extinction is another area of
 9 8 macroevolution that's very important.

10 9 Q Okay.

11 10 A But mass extinction is not really on the table
 12 11 for IDC proponents, because they're more interested in
 13 12 questions of how life evolves than it how it gets
 14 13 souffled out.

15 14 Q In other words, am I understanding you there,
 16 15 since their focus is on trying to explain the mechanism
 17 16 of change, they're not, from a genetic standpoint, a
 18 17 biology standpoint, that find themselves less concerned
 19 18 with some of these environmental factors that you've
 20 19 pointed to, which can, if I understand you correctly,
 21 20 just as readily explain why a given species endures
 22 21 through time?

23 22 A Well, I'd say that their issue is more focused
 24 23 on origins than anything else. And origins is one part
 25 24 of macroevolutionarily study. And as we've seen,
 26 25 there's others. Such as extinctions, such as geographic

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2 1 change in the distribution of species. And yes, the
 3 2 change in their climate and things. And IDC is not
 4 3 really terrifically concerned with those things. They
 5 4 tend more to focus on the process of evolutionarily
 6 5 change itself and whether our understanding of this can
 7 6 account for the differences among organisms.

8 7 Specifically, what I'm taking issue with here,
 9 8 is the characterization of macroevolution. Because it
 10 9 suggests, A, that it must be a completely different kind
 11 10 of change. As you put it, genetic change, that is
 12 11 possible for them. Whereas, biologists don't seem to
 13 12 think. There's no evidence that says it's really
 14 13 different. It says that, rather, it's more a net effect
 15 14 of cumulative changes in a lineage in structure and
 16 15 function and behavior through time that result
 17 16 ultimately in differences that do seem to separate
 18 17 groups of organisms that once were fairly similar.

19 18 Q Does -- can paleontology prove that process you
 20 19 just described?

21 20 A If I could just say that I don't -- I think the
 22 21 word 'prove' should be reserved for mathematics.

23 22 Q Okay.

24 23 A But that's right.

25 24 Q Forgive me. I'm using it as a layman.

26 25 A No. Because scientists do -- many scientists,

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2 1 comparable to what is in populations demonstrated by
 3 2 natural selection. It's just that, as I explained
 4 3 before, we can't measure the power of selection in
 5 4 fossil populations. This is on a bigger scale. I can
 6 5 give you an example.

7 6 Q Do, please.

8 7 A We can look at the evolution of the wing in
 9 8 birds as an example of this. The wing involves several
 10 9 things. The bones of the arm and the fingers, the hand,
 11 10 those are changing. Feathers are evolving. They have
 12 11 to form a wing, an airfoil that's capable of supporting
 13 12 the animal in the air. There has, also, to be a flight
 14 13 stroke that is movement of the forelimbs that actually
 15 14 powers the animal forward. This is a very precise
 16 15 motion in order to make this work. And there are also
 17 16 changes in the neuromuscular components, the brain, the
 18 17 physiology, the base on metabolism. All these things
 19 18 are built into how we understand flight-originating
 20 19 birds.

21 20 And we now have small dinosaurs that are not
 22 21 birds, but are closely related to them, and they have
 23 22 feathers. They have feathers of different shapes,
 24 23 forms, sizes. And these feathers are not as big as the
 25 24 feathers on bird's wings, nor are the arms yet quite as
 26 25 long as they are in birds, even the first birds. And

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2 1 chemistry, physics, especially working on experiments,
 3 2 do talk about proof. I prefer to sort of use the term
 4 3 'support' or 'establish' or 'demonstrate,' by which we
 5 4 mean that certainly our conclusions are open to
 6 5 modification, but it's a pretty good show.

7 6 Yes. I think paleontology can do this in many
 8 7 cases. Paleontology with broadly to incorporate
 9 8 elements of functional morphology, physiology,
 10 9 comparative anatomy, which is all the stock and trade of
 11 10 Paleontologists, even though they are also studied as
 12 11 separate disciplines.

13 12 Q Let me -- I'm trying to figure out the ways in
 14 13 which, when you look at paleontology and it sort of --
 15 14 well, let me ask you this, can it prove or can it
 16 15 sufficiently demonstrate, to your satisfaction, sort of
 17 16 the mechanism of natural selection?

18 17 A Again, I would prefer to use the demonstration
 19 18 of adaptation as a proxy for showing selection.

20 19 Evolutionarily biologists and, in particular, those who
 21 20 work on microevolution, have defined adaptation as the
 22 21 result of natural selection, because they see this in
 23 22 their populational studies. We, as Paleontologists,
 24 23 don't contradict this but, rather, what we're seeing is
 25 24 larger scale adaptive changes. Each one of which, when
 26 25 broken down into smaller components, may be as

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2 1 what we see with these, with the evolution of these
 3 2 feathers, is that they're not evolving all at once.
 4 3 They start out small and very simple. Almost as hair
 5 4 like filaments. They're all over the animal's body, and
 6 5 they would have been a kind of insulation.

7 6 So the first thing we determine is that the
 8 7 original function of the simplest feathers was
 9 8 insulation. They then become branched, and they have a
 10 9 central kind of stock, the same way a feather does
 11 10 today. And the -- these feathers are simple, too, but
 12 11 we find banded color patterns on them. By which we
 13 12 infer that they had a role in display, camouflage, or
 14 13 allowing individuals to recognize members of their own
 15 14 species.

16 15 We have fossils of dinosaurs sitting on their
 17 16 nests of eggs, in which position they died, for whatever
 18 17 reasons. They're spreading their fingers over their
 19 18 eggs. These fingers in related dinosaurs have long
 20 19 feathers coming off them, by which we infer that these
 21 20 feathers also serve to protect the eggs when dinosaurs
 22 21 were brooding. So here are three functions of feathers
 23 22 that are simpler than the feathers in a bird's wing that
 24 23 evolved before feathers and such were used for flight.

25 24 So we're looking at a sequence of cumulative
 26 25 changes as feathers eventually become larger and more

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1 complex and finally, air worthy. And eventually, the
2 function of flight evolves, as well.
3 Q Let me stop you there and ask you a few
4 questions to see if I'm with you. First, when we
5 started out talking about whether paleontology could
6 show the mechanism of natural selection, and I think
7 what you said there is, not directly, but you use
8 adaptation as a proxy for that?

9 A That's right.

10 Q By looking at the persistence of a given
11 adaptation, which I think results in the enduring, if I
12 may say that, of transitional features; is that correct?
13 That -- once that becomes adaptive, it's a positive
14 thing. So that's how -- that's the way in which
15 paleontology tries to put its finger on the mechanism of
16 the natural selection?

17 A (Witness nods head.)

18 Q That's a yes?

19 A Yes. That's as close as I think we can get.

20 Q Okay. Now, here with the feathers -- I was
21 going to ask you about this, because this is absolutely
22 fascinating. What you seem to be saying is, that there
23 are features that are developing, which initially don't
24 have a function, they acquire later on. That's one
25 thing. But as I trace through that process which you

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1 have many functions, some of which we can track now in
2 these extinct dinosaurs that weren't birds and didn't
3 fly, but were closely related to them.
4 Q You know, as I look at your description of the
5 fossil record, what is the -- what does punctuated
6 equilibrium show about natural selection, does it show
7 anything?

8 A I wouldn't think so. I think it more is an
9 idea that describes the pace of what we call
10 morphological change. That is, change in features of a
11 lineage.

12 Q Okay. As opposed -- now, when you say change
13 in features of a lineage, is that new species or not?

14 A The -- it is an idea about speciation that's
15 based on morphological change. So here is a lineage
16 that basically is not changing very much through a long
17 period of time. Then in a relatively short period, it
18 seems to make a change that distinguishes it comparably
19 as a new species. In other words, the new guy is
20 distinct enough from the old guy that it would be
21 characterized as a species by anyone who looked at it
22 with a professional understanding. And if -- and how do
23 we know that these things really are species in the
24 fossil record? We quite often do it by comparing them
25 to related living forms to see if they actually have the

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1 sketched out here and given a lot of time and thought
2 to, it seems like at every stage in the process, you're
3 inferring a function that allows the -- if we could
4 call -- I don't know what you call, I'm sure you have a
5 word for them -- the precursor to the feather, to
6 develop, it's got a function. And that's, you're sort
7 of weighing the evidence. You should make those
8 inferences. The first you say are hair-like?

9 A Yes.

10 Q All right. And you have inferred, you made a
11 reasonable judgement, if I may, that that's probably an
12 insulation function?

13 A Yes.

14 Q Okay.

15 A Because, if I may add. By comparison to
16 similar structures in living animals, hair-like fur in
17 mammals, hair-like feathers in things like kiwis, very
18 simple feathers, these have an insulator function.

19 Q Okay. Then the same thing as you go along
20 through the -- as you trace out the process at each
21 stage, you're looking at what you see in the fossil
22 record in light of what you see in other fossils, and
23 then it appears current living animals with a similar
24 feature?

25 A Yes. And so in birds, we observe that feathers

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1 same kind of and degree of differences. And it turns
2 out that the studies that have been done say, yes, they
3 do. So they are consistent with difference we see in
4 species today.

5 Q Okay. And you sort of read those back into the
6 fossil record and say, these are more -- this difference
7 between fossils is more kin to the difference we see in
8 these two living examples?

9 A Yes.

10 Q Okay. And we know these two living examples
11 are a different species for a variety of reasons. And
12 therefore, we infer that these fossils -- remains must
13 also be.

14 A Yes. And therefore, for animals that are
15 completely extinct, we use the same kind of degree of
16 difference --

17 Q Okay.

18 A -- to establish that.

19 Q Okay. To establish the classification as a
20 different species?

21 A Yes.

22 Q When you -- again, I'm just trying to
23 understand. Does -- is there a theory in paleontology
24 as to how this punctuated equilibrium relates to the
25 mechanism of natural selection? I mean, can it be

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1 accounted for by the existing theory?
 2 A This is going to get complex. I'm sorry. But
 3 when --
 4 Q Is it yes it can?
 5 A It can.
 6 Q Can exist in theory account for punctuated
 7 equilibrium?
 8 A Yes.
 9 Q Just give me as brief an explanation as you
 10 can, so I can --
 11 A When it was proposed, the idea was that the
 12 reason that you're seeing no change for a long time is,
 13 basically, that organisms are more or less happy with
 14 what they're doing. So they don't change very much.
 15 One possible explanation that was proposed is that a
 16 population on the fringe of the whole range of the
 17 species diverges in form from the others. This can
 18 happen quickly in semi-isolated small populations,
 19 particularly. Evolution can happen especially fast
 20 in -- that was always the prevailing understanding.
 21 And then the idea was that this fringe
 22 population could then come back into the main range and
 23 sort of swamp or take over, out compete, or for
 24 selective, or whatever reasons, take over that parent
 25 population's range, and then persist through time after

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 2 1 that. That supposition or idea is very difficult to
 3 test, but it was based on the prevailing understanding
 4 from population biology of the 1950s, 1960s and earlier,
 5 that established that this could happen in populations
 6 today. Therefore, the suggestion was made that maybe
 7 this is what's going on in fossil population, but we
 8 couldn't directly test it.
 9 Q But that is the way, currently, paleontology
 10 deals with this notion of punctuated equilibrium, that's
 11 the sort of working hypothesis, if I may?
 12 A It's one idea, Pat, but I don't think it's one
 13 that's very strongly explored, because it's just very
 14 difficult to get information about that stuff. It's --
 15 questions about punctuated equilibrium relate much more
 16 to the pattern that we're describing of not gradual
 17 change into the new form but, rather, persistence of a
 18 form, and then fairly rapid change and then persistence
 19 after that.
 20 Right now, Paleontologists, when they work on
 21 this question, are still trying to ask whether this is
 22 the prevalent pattern in the fossil record, how common
 23 is it, how rare is it. We need a lot more information
 24 about that.
 25 Q Okay. So I understand you, is it -- in other
 26 words, the very existence of punctuated equilibrium, as

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 2 1 you see it, is an open question in paleontology at this
 3 2 time?
 4 A No. It's been demonstrated in a great number
 5 of cases. The question is, has it been assessed for all
 6 possible cases. And the answer is, no. It's still a
 7 fraction. We have a quarter of a million species in the
 8 fossil record. Some of them, you could ask that
 9 question of. Many of them, you could see not. But the
 10 number of cases that you could ask that question has not
 11 been fully assessed.
 12 Q So again, just so I understand you, is it your
 13 view that, in light of these difficulties you've
 14 described, some of which it appears arise from the
 15 incompleteness of the fossil record versus, in certain
 16 areas, it's not yet clear whether punctuated equilibrium
 17 is a general characteristic of evolutionary change?
 18 A It's not clear whether it's more common than
 19 gradual change. And if so, how much more common.
 20 Q Okay.
 21 A Does it apply to 90 percent of cases or 40
 22 percent of cases? In either case, whether you have a
 23 punctuated pattern or a gradual pattern, selection could
 24 still be working.
 25 Q And I guess that's -- that's, you know, again,
 26 what I was trying to get you to explain to me, is how

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 2 1 does punctuated equilibrium fit in with the selection
 3 2 process that we've discussed today? Now -- at least how
 4 do paleontology see that?
 5 A I don't know that it's been extensively
 6 explored.
 7 Q Do Paleontologists -- I'm sorry. Were you
 8 done?
 9 A That's all I can say about it. I don't know if
 10 it's been extensive.
 11 Q Is there --
 12 A It's a good question.
 13 Q That's a good question.
 14 Is there a working -- you've described this
 15 notion of the range, a group on the periphery, you know,
 16 and so on, sort of displacing the parent population
 17 based on an advantage they received while on the fringe
 18 of the range, as you put it, and indicated that, in some
 19 measure, that sort of working hypothesis was derived
 20 from sort of current observable evolutionarily
 21 phenomena. Is there any other hypothesis that's being
 22 worked on?
 23 A Let me say first to maybe clarify your earlier
 24 question. That the very process of coming in and
 25 replacing, out-competing, or whatever, if that model
 26 were correct, would be a selective process.

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1 Q Okay.
 2 A Could we observe the selective process in the
 3 fossil record, no. We could observe its effects and
 4 infer selection is one possible mode. Would there be a
 5 difference between punctuation and gradual change in
 6 that regard? No. Because gradual change of a
 7 population was also traditionally understood to be the
 8 result of selection, little by little on a lineage
 9 moving through time. The same kind of selection that
 10 people have observed in population cages in the wild and
 11 in laboratories for flies, flour beetles, and so forth;
 12 and that Darwin wrote about, early in the origin of
 13 species when he was talking about domestication of
 14 plants and animals, which is known by the term
 15 'artificial selection,' but it has the same effects as
 16 natural selection, when he posits it.

17 So to come back to your question, does
 18 punctuated equilibrium involve selection? By inference,
 19 it would, as gradualism would. It just would act in
 20 slightly different patterns.

21 Q Okay. And then in terms, again, if I -- I'm
 22 trying to look at this mechanism, the mechanism of
 23 natural selection. Again, I just want to make sure. It
 24 seems like there's some genetic event that produces a
 25 change; is that accurate? And then, there's the

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1 1 interplay between that genetic change and the
 2 environment, which confers the advantage, and results in
 3 selection; is that an accurate --
 4 A I would say that change -- let's see. Change
 5 can happen for several reasons. The environment can
 6 force it, for want of a better word. Either you do this
 7 or you become extinct. Or, it may present an
 8 opportunity to which variations that organisms can
 9 express might be able to take advantage of. I know that
 10 syntax was convoluted.

11 So it's -- it can work in both ways. We cast
 12 evolution as genetic change, and that's true because
 13 it's all heritable. We often perhaps underplay the
 14 importance of behavior, flexibility in evolution. If
 15 the phenotype is not flexible, that is to say, if
 16 organisms cannot react to changes, obstacles, and
 17 opportunities in their environment, then they won't have
 18 as much success as those that can take advantage of
 19 change. And so behavior is a big -- and I think, in so
 20 far as it regards flexibility, is a big part in here,
 21 too.

22 Those plants we talked about before that find
 23 their way up to the mountaintop, we know that sometimes
 24 they will be stunted because the conditions are harsh,
 25 but if we take some of their seeds and plant them back

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1 1 on the flats, they'll grow perfectly fine in the next
 2 year. All this is telling us is that the organism is,
 3 that is the individual itself, is experiencing insults
 4 to its growth by the environment, the same way we would
 5 by scars or injuries or damage as we would be growing
 6 up. But through time, if there are variations in those
 7 populations that -- that naturally make these plants
 8 shorter or able to withstand cold more or able to bloom
 9 faster, those variations in the population, which
 10 incidentally, are mutations, they are simply alternative
 11 forms of genes, like we see all through our populations.
 12 Then those would be selected upon, and that will become
 13 a genetic hardwired thing, so that when you transplant
 14 those seeds down to the flats, they will still be
 15 stunted, they'll still be short plants like they were up
 16 in the hill.

17 Q Okay. So that's -- and that is what I'm just
 18 trying to get a handle on here. It's -- that component
 19 is when we would traditionally think of it as a
 20 different species; is that correct? When it's -- it's
 21 acquired or made its own, these changes that allow it to
 22 do well in the new environment on the mountaintop, but
 23 not in the old environment?

24 A Whether they are a new species is a proposition
 25 that we could test. We could examine that, and we would

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1 1 do it by trying to cross them. If they could not
 2 reproduce, then we would say, yes, of course, they're
 3 separate species. If they couldn't reproduce, but they
 4 were up here in the mountaintop and down here and they
 5 really weren't going to practically do that anymore,
 6 then we would see them as different species for
 7 geographic and ecological reasons.
 8 (Recess.)

9 9 BY MR. GILLEN:

10 10 Q Kevin, I want to see if I can wrap up this part
 11 of these questions. Which, again, I ask you to forgive
 12 me. I'm just trying to understand your discipline.
 13 13 It seems -- is this true that -- we've
 14 discussed a number of facets or dimensions that come
 15 into play in describing evolutionarily change in
 16 species, and it seems like one element of some of our
 17 17 discussion is focused on this genetic facet of it; the
 18 18 role of genes and producing the -- certain changes. And
 19 19 based on what you said, I would -- is it accurate that
 20 20 particular facet of the process, that's not the
 21 21 principal subject matter of paleontology?

22 A The gene structure, no.

23 Q Okay. And the mechanism of gene change?

24 A Correct.

25 Q And then, we've discussed this mechanism of

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1 natural selection. And I've been trying to understand
 2 how paleontology speaks to that. And I think -- I want
 3 to see if I've understood your testimony so far. It's
 4 that it -- paleontology identifies the fact of selection
 5 by tracking these changes, looking at, I believe you
 6 called "the proxy of adaptation"?

7 A I think that's accurate, yeah.

8 Q Okay. And then, as I was thinking about your
 9 testimony this morning over the break, it occurred to me
 10 that that, in a way, the mechanism of the -- the
 11 mechanism of the selection, what makes a change
 12 advantageous is likewise, sort of a subject of
 13 reasonable inference on the part of the Paleontologist.
 14 He sees the pattern of adaptation, he infers that
 15 there's selection at work, and then, along the lines
 16 that you've testified to this morning, you sort of use
 17 what you know from various disciplines, current species
 18 and the like, to make an inference as to what the
 19 precise mechanism of selection was in a given case; is
 20 that accurate?

21 A What the selective forces are, what we might
 22 say.

23 Q Okay.

24 A Or what the opportunities were that were being
 25 taken advantage of. And we look at that, as we

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 2 discussed, by studying functional, elaboration change,
 3 "improvement," in quotes.

4 Q Okay.

5 A In a lineage through time. And you're right
 6 that -- although, we don't directly study the genetics,
 7 we are working on what are obviously heritable changes,
 8 not simply accommodation to local conditions by any
 9 given organism at a time, sure.

10 Q So now -- then we have this work that you've
 11 done on the wing. And I began to read it, and forgive
 12 me, but it's fascinating, but I can't follow it all the
 13 way through. If I look at that, as an example, I see
 14 you as applying the principles we just thought of as
 15 looking at the changes, and then because they're
 16 enduring, your mind as a Paleontologist, looking for,
 17 well, why would that be, what advantage could be
 18 presented by this developing feature; is that accurate?

19 A Well, we look at -- you're correct that when we
 20 look at similar features in, for example, feathers and
 21 other structures of living birds, we can get a better
 22 sense of what those things might have done as the same
 23 structures in dinosaurs that weren't flying.

24 Q Okay.

25 A So it's not just looking at the structure and
 26 making a guess about -- or an inference about things.

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 2 It's rather reasoning based on comparative evidence. So
 3 we know what the functions of the feathers of different
 4 shapes are in birds today, we can look at those same
 5 structures in fossil animals and go, oh, well, that's
 6 probably what they were doing there. In the case of
 7 these little hair-like feathers even that cover the
 8 whole body, we know these are de facto insulation. They
 9 would have to be insulator or they couldn't simply exist
 10 on the body and not have something to do with warming or
 11 cooling. Yeah.

12 Q Okay.

13 A Okay.

14 Q And then, let me just get that so that I
 15 understand you. When you say we know they're
 16 insulation, because you're saying the fact of their
 17 existence, they have to either warm or cool based on
 18 what we know about hair?

19 A Hair and feathers today, that's right.

20 Q Okay. And then -- but if you see them enduring
 21 through time, and therefore, being properly classified
 22 as an adaptation, I believe, something that's a positive
 23 development; is that accurate, Kevin?

24 A I think we can call them adaptations if we can
 25 show that their structure as a change from a previous
 26 structure would confer some function that wasn't there

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1 before, then we can start talking about new functions,
 2 which, presumably, are adaptive. Because if they were
 3 maledapted, bad for the organism, presumably, they
 4 wouldn't have survived. And if they were of neutral
 5 value, why would they be there at all in the first
 6 place.

7 Q All right. And that's exactly what I was
 8 trying to get a handle on. There's an inference that if
 9 they're enduring, they're conferring an advantage,
 10 because otherwise they drop off?

11 A We do this for some features. We don't pretend
 12 that every confirmation of every structure has a
 13 function that's incredibly adaptive. Otherwise, we'd
 14 lose our minds. But we don't -- for example, the shape
 15 of the bridge of the nose, we could make up stories
 16 about it being adaptive, but frankly, they don't work.
 17 And they -- the bridge of a nose is not there in order
 18 to hold your glasses. So we kind of draw that line at
 19 some -- at making inferences about everything.

20 Q And in that line, Kevin, is it drawn -- just
 21 along the lines here, your answer suggests sort of a
 22 plausibility. Is there a plausible explanation to be
 23 advanced for the feature to be understood as
 24 advantageous?

25 A We generally focus on adaptations that we think

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1 are of some strong ecological or functional importance
 2 like wings, ears, flippers, just things that help an
 3 organism in the way it performs so much of its daily
 4 life. We may not worry about the configurations of more
 5 minor features in every respect, you know, the shape of
 6 the ear lobes is not something we worry about as an
 7 adaptive question.

8 Q Okay. Now, let me ask you, too, when you're
 9 looking at these -- the forces of selection, then,
 10 again, is that the subject of reasoned inference on the
 11 part of the paleontologist?

12 A Yes. I would say that evolutionarily
 13 biologists of all kinds, those that work on populations
 14 or genetics, would accept that when paleontologists
 15 study the evolution of an adaptation, like the wing or
 16 the flipper or whatever, that this is the result of
 17 natural selection, even if we can't directly measure it,
 18 but by extrapolation, from what it is observed in
 19 populations. And knowing that these species or in these
 20 lineages that we're watching change, are simply, when
 21 broken down, consisting of smaller lineages like we see
 22 today, changing like we see today, then it's all of a
 23 continuum.

24 Q Okay. And when -- I think my question was
 25 imprecise. When we look at what is allowing certain

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 2 branches to endure and certain to -- you know, certain
 3 to be become extinct, there, as I understand your
 4 testimony, we understand that there's this causal
 5 connection between the features and the environment and
 6 there's some way in which in the features that you're
 7 seeing persist through time are conferring an advantage.
 8 And as a paleontologist, you're trying to get a line on
 9 that advantage.

10 Q What I'm just trying to get straight, in my
 11 mind, is this idea that when you do that, it consists,
 12 in you as a paleontologist, looking at a variety of
 13 possible explanations for the advantage that could be
 14 conferred by the feature you're focused at a given time,
 15 and then entertaining a hypothesis in that way; is that
 16 true?

17 A Yes.

18 Q And I want to ask. I mean, you have a very
 19 interesting comment about your -- one of your mentors, I
 20 think, John Ostrom?

21 A Yes.

22 Q And I think you called it, at one point, he had
 23 a view, which I understand that you do not agree with
 24 the way in which it's been portrayed in Pandas?

25 A Yes.

26 Q What I'm interested, though, just in the

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1 process that led your mentor to first advance the
 2 notion, as a hypotheses, and then, as you put it in suc'
 3 a gentlemanly way, to sort of retrack it, when he
 4 thought it wasn't tenable. Because that, I think --
 5 that will help me get a handle on -- let me get a page
 6 here.

7 MR. ROTHSCHILD: Page 13.

8 MR. GILLEN: Thank you.

9 BY MR. GILLEN:

10 Q I'm not interested in the conclusion
 11 particularly, or in the -- in any way discrediting your
 12 mentor. That's not my point. I just want to see like
 13 what, as a way for me to understand the process, the
 14 judgements that you're making, you're familiar with this
 15 work. What was it that led him to advance that notion
 16 that, well, maybe it was a --

17 A Insect net.

18 Q Yeah, insect net. You can say that. I don't
 19 want to.

20 A He called it the insect net. It was very
 21 funny.

22 He reasoned that the first birds were small,
 23 and that they came from small dinosaurs that were
 24 carnivorous. Well, if you're small and carnivorous,
 25 what can you eat. You can eat little lizards, you can

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1 eat baby whatevs, but you can certainly eat insects.
 2 And an animal the size of a chicken or pigeon running
 3 around in the Jurassic is likely to do what such animals
 4 of that size do today, which is eat insects.

5 And so -- and he knew from its structure that
 6 it's a bipedal animal. It's running around on its back
 7 legs. Its forelimbs are free from locomotion. It has
 8 relatively long arms. The arms are almost as long as
 9 the legs. And it's got very long and prehensile fingers
 10 capable of grasping. And if you have feathers, even not
 11 very long ones, attached to these fingers, and you were
 12 running along trying to catch insects, wouldn't it help
 13 you to have big flyswatters on your hands.

14 Now not that there was any direct evidence for
 15 such long feathers on the animals, he knew at the time,
 16 in fact, there wasn't. Now there is. But his proposal
 17 was based on an inference of what he could tell about
 18 the probable ecology of the animals that the first birds
 19 came from and going from there to a wing with long
 20 feathers that could be used in flapping and flying; he
 21 proposed that there would be an intermediate stage based
 22 on what he would regard as a reasonable guess about its
 23 possible function in ecology.

24 As it turned out, a few other scientists were
 25 sitting down over, you know, coffee one day, one was an

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 2 1 ornithologist, one was a chemist, one was a physicist,
 3 and they started to talk about this. And as people do,
 4 you know, scratch notes on a napkin, and these guys
 5 said, you know, I've been reading this paper -- which he
 6 wrote a popular paper in a scientific magazine --
 7 reading this paper, and he said it just doesn't make
 8 sense, because if an animal jumped up and grabbed
 9 insects like that, it would lose its equilibrium and
 10 tumble over. And they showed how that actually was the
 11 expected result.

12 Now, they didn't establish or prove that, but
 13 they said this would be a problem. They said, instead,
 14 if the animal is running along with its hands out to the
 15 sides, if it jumps up to grab the insect with its mouth,
 16 the proto wings now here are stabilizing the animal and
 17 increasing its lift, and maybe that's good in the
 18 process and it wouldn't go tumbling head over heals.

19 And John, when he saw this paper, which I
 20 remember was sent for review, he said -- he said what do
 21 you think about this. And I said, I think they got it
 22 right. I think it's really a much more important
 23 function in getting aerodynamics than in distracting it
 24 for another function, which would really take it off the
 25 path of improvement toward flight.

26 And John, who always had his own ideas and was

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 2 1 a very good reasoner about things, agreed quite readily.
 3 And he later wrote in a paper that he published, the
 4 insect net hypothesis is dead, it served its purpose.
 5 Because he put out a hypothesis that these guys were
 6 able to chew on and show the problems with this, but,
 7 you know, we've got maybe, if we just adjust it this
 8 way, move the prey catching function from the hands to
 9 the mouth and use these instead for balance and lift,
 10 then we'll get a better result.

11 Q Now, is that -- I admire, too, the openness to
 12 the other hypothesis. I mean, that is beautiful.

13 Is this an example of what you called
 14 functional morphology?

15 A. Yes....

16 Q Okay. Let me just ask you another question
 17 about the Cambrian Explosion and the fossil record. In
 18 your report, you take issue with Meyer's effort to
 19 explain the pre-Cambrian Explosion. And I notice that
 20 there you -- in connection with that observation of
 21 yours, I think it's on page 16.

22 MR. ROTHSCHILD: Just for the record, it's just
 23 Cambrian Explosion. That's part of the problem.

24 MR. GILLEN: Thank you.

25 BY MR. GILLEN:

26 Q You say there that the Cambrian Explosion has

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 2 1 been known for decades to be mainly a problem of fossil
 3 2 preservation?
 4 3 A. Yes.
 5 4 Q Now, I just want to get a sense of what that
 6 5 means to you as a paleontologist. What is the problem?
 7 6 A. The problem is that we have to read the life of
 8 7 the past from the preserved rocks. The problem is that
 9 8 the longer rocks lay around, the less chance you have of
 10 9 finding what you're looking for. Rocks that are 15
 11 10 million years old are far more likely to be preserved
 12 11 than rocks that are 500 million years old. Lots of
 13 12 things happened in this interim.

14 13 We have no sea floor older than the Jurassic
 15 14 about 200 million years ago. The reason is, that
 16 15 continental plates keep moving up against each other.
 17 16 And as they hit each other, quite often, one of them is
 18 17 drawn down into the earth beneath the other one. That
 19 18 crust then becomes recycled, melted and lost. This has
 20 19 been going on for so long that we have no sea floor, as
 21 20 I said, older than 200 million years ago, which is not
 22 21 very -- it's only a part of the fossil record.

23 22 The Cambrian forms we're talking about lived on
 24 23 the ocean floor. So the only place now that we're going
 25 24 to get records of ocean floor older than this is if that
 26 25 ancient ocean was somehow thrust up on the continental

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1 1 surfaces and preserved, not eroded, but exposed to the
 2 2 surface now so that we can uncover it and find things.
 3 3 You can imagine that the chances of getting a complete
 4 4 record of something as far back as the Cambrian and
 5 5 immediate pre-Cambrian, are very small. We have pieces
 6 6 here and there. Like a book in which you're pulling a
 7 7 bunch of pages out from one chapter, and then skipping
 8 8 20 pages and pulling -- you know all the metaphors.
 9 9 It's the same idea.

10 10 Q But it is interesting and you are helping me
 11 11 understand.

12 12 Is it that, therefore, there's various strata
 13 13 in the Cambrian and you -- what's lacking is a piece, so
 14 14 to speak, that allows you to get through the strata that
 15 15 are associated with that period?

16 16 A. Let's say that there are increasingly more gaps
 17 17 in the record, all things considered, the farther back
 18 18 we go. It's as if you had a stack of paper, and from
 19 19 the -- moving from the top, you pulled every other page
 20 20 out, and then as you got farther down, it was every
 21 21 third page, and then every fourth page. By the time you
 22 22 got to the bottom, you'd be taking every twentieth page,
 23 23 and you wouldn't have a very good sense of the
 24 24 continuity of the -- you might -- on those pages, there
 25 25 would be lots of available information. You could,

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1 depending on what sort of document you were looking at,
2 connect those pages even though they might be 20 pages
3 apart. Does that help?

4 Q I think so. Are you saying then, Kevin, that
5 the problem of the Cambrian Explosion is that it may
6 appear more explosive than it was simply because we're
7 missing the intermediate strata or pages that would
8 allow you to see a more gradual transition of the kind
9 you see in other periods?

10 A That's a part of it. Yes. That's a big part.
11 And the other part of it is, that there is -- the other
12 part is the question of how to read the pages that are
13 preserved. So in the early Cambrian, the so-called
14 Explosion, is occurring in a five, ten million-year
15 period, which is a lot of time. It's not an instant.
16 And a lot of the major groups of sea animals that we
17 know today are found by the end of that Cambrian
18 Explosion. They don't all appear at once.

19 And there are also indications of those animals
20 before that five to ten million year bracket. In faunas
21 of very small-shelled animals from five million years
22 before that, for example, we have mollusks of various
23 kinds. We have brachiopods. We have other calcite
24 tubes that suggest various kinds of worms or other
25 animals. And some things we just can't really tell that

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2 understand you. You've given us now an increasingly
3 longer period of time prior to the pre-Cambrian.
4 A Cambrian.
5 Q Sorry, Cambrian.

6 And the -- in which, if I understand you
7 correctly, you're saying these are precursors to some --
8 or, arguably precursors, to some forms that we see in
9 the Cambrian period; is that accurate?

10 A We conclude that they are members of the
11 metazoans, if very primitive ones. We do not
12 necessarily say that they are the embryos or the tracks
13 of lobsters or clams or anything like that. We simply
14 know them as metazoans in the same way that we have
15 horses and elephants and impala today. But if we went
16 back 50 million years to their ancestors, and looked
17 around North America and Africa, we wouldn't recognize
18 anything like a horse or a springbok or an elephant that
19 we see today. We would see much more archaic-looking
20 animals.

21 Q And then you made a statement to the effect
22 that the presentation of this subject matter was
23 deficient in your judgment. Tell me why, just explain,
24 what is it, you said it's true as far as it went, but
25 you thought it was not the way to explain it to
schoolchildren.

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2 they have any further relatives.

3 If we go back 20 million years before that, we
4 have the burrows of animals that are progressing along
5 the ocean floor. They're kind of trackways, if you
6 want. And these are just linear worm type things going
7 along. But we know that those animals must have had a
8 head and they must have had legs or some kind of
9 locomotory ability to go forward.

10 Therefore, they have features of the organisms
11 that we find at the Cambrian Explosion. We call those
12 animals metazoans, which are generally multi-celled
13 animals.

14 If we go back 70 million years before this
15 Cambrian Explosion, we have the remains of embryos.
16 Amazing to find them, but you never know what's going to
17 be preserved. These embryos have complex features that
18 are associated with metazoans. So we know that at least
19 some early members of the metazoans must already have
20 existed 70 million years before the Cambrian Explosion.

21 These facts were ignored in the treatment of
22 the Cambrian Explosion by the Intelligent Design
23 proponents. Was what they said true as far as it went?
24 In part, it probably was. Is this the way to explain a
25 problem like that to schoolchildren? No.

25 Q When you say that, Kevin, let me just

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2 A I think without including evidence of the small
3 shelly faunas of the bilateral trace fossils, and of the
4 ancient embryos, you are pretending that all this change
5 is happening in a much briefer window than it actually
6 appeared in. And I don't know why someone would want to
7 do that.

8 Q So you -- in other words, it -- how should we
9 say -- it exaggerates, in your judgement, the sense of
10 explosion by failing to trace back to these precursor
11 forms?

12 A By leaving out all of the important information
13 that could relate to a more distant genealogy.

14 Q Okay. And that's what I'm trying to get at.
15 You say this earlier information that could relate to a
16 more distant -- did you say genealogy?

17 A I did.

18 Q Okay. Is it -- is the view that you described,
19 is that an accepted view in paleontology?

20 A Yes.

21 Q And so, therefore, is it -- I just, again, want
22 to make sure your objection is that it seems this
23 treatment in Pandas is -- has an artificial temporal
24 boundary imposed on this examination of connections?

24 A Yes.

25 Q Okay. On page 15, Kevin, you are speaking, at

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1 the top of that sentence beginning at the top, to the
 2 fossil record, and the way in it's inductive. And you
 3 say there, "We" -- I believe you're referring to your
 4 profession community of paleontologists -- "derive
 5 general inferences based on countless examples, which
 6 present us with repeatedly tested and confirmed patterns
 7 from which the history of life is reconstructed."

8 And then you go on further. I just want to
 9 understand, is that -- is that statement there, a
 10 reference to what we've discussed this morning.

11 A Every time we go in the field and find a new
 12 specimen, it provides another -- we would say datum,
 13 singular of data -- point. Another piece of information
 14 that tests our ideas about what we think we know of
 15 the -- of the pattern of life through time. If I was
 16 working in Cambrian strata and let's say I found a horse
 17 tooth, that would be a little unusual. We don't know if
 18 horses anywhere back that far. And immediately, of
 19 course, we would want to see whether this was a correct
 20 identification, whether it was something that washed in
 21 from another place, whether -- any other possibilities.
 22 But we don't find those things.

23 When we go out, we find the usual trilobites
 24 and ancient snails and other sea creatures that lived
 25 then on the ocean floor. They don't really jar our

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 2 1 understanding. And that's what I mean by being
 3 confirmed by countless examples. Every time we go out
 4 to do this, we're actually testing our whole theory of
 5 the fossil record.

6 Q Now, I do have a better understanding at what
 7 you're getting at.

8 So in other words, you're -- there's a
 9 consistent yield from a consistent period or -- how
 10 would you describe it? There's a consistent yield of
 11 similar fossils from a rock sample that's associated
 12 with that period. Is that what you're getting at?

13 A We keep getting the same signals, that's right.
 14 Q Now, just to go -- you go on there. These
 15 patterns -- and that's what we're talking about -- and --
 16 the processes inferred to produce them. Now, when you
 17 say that, Kevin, what are you getting at there? The
 18 process inferred to produce them?

19 A The processes of evolutionarily change we've
 20 talked about.

21 Q All right. "Are in turn based on conventional
 22 scientific methods."

23 A What are you getting at there?
 24 A That when our methods can range from anything
 25 from the rigors of typical and correct field collecting

26 to the rigors of correct identification of specimens,

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1 their classification. The correct identification of the
 2 type and age of the rock we're looking at, the
 3 reconstruction of their environment, such things like
 4 that.

5 Q Okay. So now, are those methods that you've
 6 described, are they dating methods or are they dating
 7 and morphology comparisons, how would you --

8 A They are dating -- they're situating in time
 9 and space. And relating those to other data we have of
 10 organisms we have in time and space.

11 Q The dating or situating in time and space, as
 12 you described it, what exactly is that? Is that
 13 comparing this find against what we know what the
 14 discipline holds today about geologic time and geologic,
 15 I guess, strata?

16 A Yes. Which, in turn, is based not only on
 17 geology, but on the principles of physics and chemistry,
 18 and so forth, which allow us to put what we call
 19 absolute dates on ancient rocks.

20 Q Okay.

21 A Paleontologists and geologists, just in the
 22 field, can look at different rock outcrops and say this
 23 one is higher or lower than the other. That's basically
 24 the way the whole geologic rock column is established,
 25 but no one knew exactly how old these rocks were. That

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1 depended on isotopic dating that was based on the
 2 understanding of radioisotopes that came directly from
 3 physics and chemistry, having nothing to do with
 4 paleontology, biology or evolution.

5 Q And then, you've also indicated that another
 6 element of this -- of the method, the method of
 7 paleontology is the morphology -- the classification?

8 A Yes.

9 Q Is that what we discussed earlier today?

10 A With that funny word, synapomorphies,
 11 everything associated with it. How we classify
 12 organisms in the tree of life, yeah.

13 MR. GILLEN: Let me ask Ana to mark this as
 14 Exhibit 2.

15 (Defendant's Exhibit 2 was
 16 marked for identification.)

17 BY MR. GILLEN:

18 Q I know, Kevin, I just want to get some
 19 additional detail on your notion that -- whether you
 20 have an opinion concerning whether Intelligent Design
 21 Theory or Intelligent Design Creationism, as you call
 22 it, is a science properly -- considered as a science.
 23 Do you have an opinion on that?

24 A My understanding of Intelligent Design is that
 25 it does not qualify as science.

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1 1 Q It does not qualify as science?
 2 2 A Right.
 3 3 Q Okay. Now, if -- I want to ask, if you look at
 4 page 15, and you have a conclusion there that the order
 5 of appearance of the major groups of plants and animals
 6 records with the expectations and patterns of the
 7 evidence and theory of contemporary evolutionary
 8 biology. Is that what we've discussed today, the way in
 9 which the findings of paleontology support
 10 evolutionarily and biology, as you understand it?
 11 A Yes.
 12 Q Okay. Now, you have an opinion that
 13 Intelligent Design is not science; correct?
 14 A Yes.
 15 Q Just tell me why.
 16 A I guess it would be more appropriate to ask why
 17 it is science. It makes no predictions that have been
 18 tested empirically. It has not shown that existing
 19 understanding is so insufficient as to warrant a
 20 completely different and supernatural explanation of
 21 patterns and processes of life. It has not ever been
 22 presented as science to the scientific community, which
 23 means that it has no standing as science in the
 24 scientific community. And it's difficult to see what
 25 would make its proponents give up its major

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1 1 stipulations.
 2 2 For example, if someone were to claim that a
 3 particular structure was so complex that it couldn't
 4 possibly have evolved through intermediate steps, but
 5 must have been created by a designer of some
 6 intelligence and presumably, supernatural features, if
 7 we then found features that -- in fossil animals, for
 8 example, that were, for all intents and purposes, to a
 9 reasonable qualified investigator, intermediate in
 10 structure, and could explain the transition of form and
 11 function, would that then falsify the claim that there
 12 was a designer. If it would, then I think we're getting
 13 out of the realm of science. And if it wouldn't, then
 14 the proposition would essentially be unfalsifying it and
 15 it still wouldn't be science.

16 Q So let me before we -- I try to understand
 17 that. Let me just make sure I got the reservations you
 18 have down. Seems like, no predictions that can be test
 19 empirically, you mentioned?

20 A No predictions that have been tested
 21 empirically, as far as I know.

22 Q Okay. It hasn't, as a theory, managed to
 23 produce a sufficiently powerful criticism of other
 24 theories to warrant displacing existing theories?

25 A But criticism of one theory is not support for

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1 1 another.
 2 2 Q Right, and I do understand that.
 3 3 Am I understanding you, that's part of what
 4 gives you the sense that -- in other words, I see what
 5 you're saying. Even if they could mount a criticism of
 6 evolutionarily biology, that wouldn't necessarily make
 7 the case for Intelligent Design. Is that your point
 8 there?
 9 A And I wonder if a criticism of evolution in
 10 biology is even necessary to posit Intelligent Design.
 11 Why can't there be a designer who works entirely
 12 according to natural processes, with no miraculous
 13 interventions? Why does this have to depend on
 14 criticism of evolutionarily theory, as we understand it?
 15 Q Is that your understanding of the position held
 16 by Intelligent Design proponents?
 17 A Insofar as Intelligent Design holds, in
 18 general, that -- that certain structures or certain
 19 phenomena in evolution could not have evolved, but must
 20 have been especially created by a designer. And insofar
 21 as the mechanisms that are posed to enable us to
 22 recognize this, includes such things as irreducible
 23 complexity and specified complexity, yes.
 24 Q Okay. Now, is it your understanding that these
 25 concepts you've referenced, Irreducible Complexity and

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1 1 then Specified Complexity, are not falsifiable?
 2 2 A Insofar as they recur to a causal mechanism of
 3 an Intelligent Designer, yes.
 4 Q And just why do you say that?
 5 A Because if structures are Irreducible
 6 Complexity, they cannot have evolved and must have been
 7 specially created. That creation must be by the
 8 intervention of some kind of -- of Supernatural Power,
 9 because it is not being discussed in natural terms.

10 Q When -- now earlier, you were mentioning that
 11 you didn't see why criticism of evolutionarily biology
 12 had to be sort of a feature of Intelligent Design
 13 Theory. And I believe you noted that there's a
 14 possibility there could be a designer operating in
 15 natural ways; is that correct?

16 A Sure.

17 Q Now, is that -- that thesis, if you call it
 18 that, do you have an understanding concerning whether
 19 that is consistent with Intelligent Design Theory?

20 A My understanding is that IDC goes farther in
 21 stipulating that no natural processes cannot account for
 22 this and, therefore, we must look for science of a
 23 Creative Intelligence that is beyond the natural
 24 processes we know.

25 MR. GILLIN: IDC is short for Intelligent

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 2 1 Design Creationism, the term used in Kevin's expert
 3 report to refer to what I have described as Intelligent
 4 Design Theory, just for the record.
 5 4 BY MR. GILLEN:

6 5 Would you have a different opinion about
 7 Intelligent Design Theory, Kevin, if the notion of
 8 change occurring through natural processes was a part of
 9 Intelligent Design Theory?

10 9 MR. ROTHSCHILD: Objection, different opinion.
 11 10 BY MR. GILLEN:

12 11 Q As to whether or not it was science?

13 12 A We would determine whether that part of it, the
 14 Intelligent Design part, was science by virtue of
 15 whether it had any consequences that could be
 16 empirically assessed. That is, with reference to
 17 phenomena in the natural world.

18 17 Q Okay. I'm having a hard time understanding
 19 what you're getting at there. Can you?

20 18 A Science is based on empirical evidence of the
 21 natural world. If someone wants to claim the existence
 22 of any sort of forces that are not natural, they may do
 23 so, but science has no regard. It's not in science's
 24 purview to talk about those things. If that's fair
 25 enough to say.

26 25 If -- for example, let's say most people or a

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1 1 great number of people accept the existence of God,
 2 accept that God set up the universe, accept that God, or
 3 whatever superior being or beings or entity, or however
 4 you wish to describe or talk about it, put in motion
 5 natural processes that resulted in everything we see
 6 around us, and I think that's the mainstream view in
 7 religion, would not have to tamper all the time with
 8 these things, miraculously, to put flagella on bacteria,
 9 wings on birds, and flippers on whales; you might say
 10 that it would be very hard to recognize the effects of
 11 the Supernatural Being like that. And we would all
 12 agree.

13 So on the other hand, it doesn't stop us from
 14 examining the appearance and the processes that are in
 15 the world around us.

16 Q That's what I'm trying to understand, Kevin.
 17 It is the notion of, shall we say, intermittent
 18 intervention, which you've referenced a few times here?
 19 Is that -- I take it, that's a notion that you've
 20 associated with Intelligent Design Theory?

21 A Yes.

22 Q And is it that which is the basis why you're
 23 saying it's not science, because rather than look at
 24 natural processes, as you described them, it's sort of
 25 just positing, as you understand it, at intermittent

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 2 1 intervention by some supernatural cause?
 3 2 A Yes. In that sense, ID becomes a science.
 4 3 What we call a science stopper. There is no reason to
 5 4 investigate this further because we have determined this
 6 5 is too complex to evolve. And therefore, some Creative
 7 6 Intelligence must be at work.

8 7 What worries me is, when they find out in any
 9 8 number of cases after having said that, that they're
 10 9 wrong, what happens to the theory? And even if you have
 11 10 a theory, do you have any cases where you can absolutely
 12 11 say this could not have evolved in any natural way.

13 12 Q Well, let me ask you, if this notion of
 14 13 intermittent intervention, in what you describe or
 15 14 perceive as natural processes, were not a necessary
 16 15 ingredient in Intelligent Design Theory, would it then
 17 16 qualify as science, in your judgement?

18 17 A It would -- if you remove notions of
 19 18 Irreducible Complexity and Specified Complexity, which
 20 19 are -- I think, it's fair to say are the only two
 21 20 postulated potential hallmarks by which Intelligent
 22 21 Design could be justified, then you have left only the
 23 22 supernatural belief.

24 23 Q So let me understand you. Are you saying that
 25 24 these two concepts, Irreducible Complexity and Specified
 26 Complexity, are necessarily connected with the notion of

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 2 1 intermediate intervention by supernatural forces?
 3 2 A I believe they have been associated with it by
 4 3 people like Dembski and Behe. Because it isn't their
 5 4 writings that we find the corpus of the approach to the
 6 5 empirical world that is not simply the Intelligent
 7 6 Design theology part that would go back to William Paley
 8 7 in the late 1700s.

9 8 Q So is it your opinion that Intelligent Design
 10 9 cannot qualify as science because it is positing this
 11 10 intermittent intervention by a non-natural process, as
 12 11 you understand it, is that the --

13 12 A It does not qualify because it hasn't shown
 14 13 this in any substantive respect.

15 14 Q When you say, "it hasn't shown this," you mean
 16 15 what?

17 16 A I mean that no one has provided any evidence
 18 17 for a case where something couldn't have evolved and
 19 18 must have been produced, therefore, by some divine or
 20 19 Creative Intelligence that is not using natural means
 21 20 that we understand.

22 21 Q Okay. Let me make just sure I understand. So
 23 22 you're saying that so far none of the proponents of
 24 23 Irreducible Complexity or Specified Complexity had
 25 24 actually produced a case, which in your judgment, cannot
 26 25 be accounted for by purely natural processes. And,

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 2 I therefore, you do not see the concepts of Irreducible
 3 Complexity or Specified Complexity as capable or as yet,
 4 demonstrated empirically?

5 A Yes. For example, what is written in Pandas
 6 about the problems of intermediate changes between birds
 7 and whatever reptiles they descended from, even when
 8 they wrote this, there was far better evidence then they
 9 had to show how those transitions could have taken
 10 place.

11 Now, in the last ten years with the evidence of
 12 the feathered dinosaurs from China, we've learned so
 13 much more about those transitions, that it's generally
 14 accepted. Not simply by the scientists that work on
 15 that, but by reporters, by textbook writers, by -- this
 16 is the consensus conclusion that's understood in the
 17 world of science.

18 Now, these guys who wrote Pandas 15 years ago
 19 ought to be going, whoa, we blew that one. Which is
 20 what scientists say to each other all time, because
 21 we -- this is -- but it's a case of where nothing has
 22 been shown and accepted by the scientific community to
 23 require an explanation of Intelligent Design. And so
 24 the question is, if this has not qualified as science,
 25 why are we teaching it as science, why are we giving it
 26 pride and place in science curriculum. I would think

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 2 that you would want to have notions that are really
 3 thoroughly tested, accepted by scientific consensus and
 4 then put into curriculum textbooks, which is the way we
 5 do all the rest of the things we've talked with.

6 Q So -- all right. I want to understand.

7 You say it doesn't qualify as science and you
 8 pointed to, I think, the fact that, so far as you can
 9 tell, there's been no case made for an organism or
 10 structure that is irreducibly complex; right?

11 A Correct.

12 Q Second, you've said here that it hasn't been
 13 presented to the scientific community and accepted as
 14 science?

15 A Correct.

16 Q Is that, in your judgement, sort of another
 17 hallmark of science, or what it takes to qualify as
 18 science?

19 A Yes.

20 Q You said that it's -- Intelligent Design is a
 21 "science stopper"?

22 A Yes.

23 Q What do you mean by that?

24 A Once someone says that, well, God did it this
 25 way or the equivalent, and there's nothing else we can
 26 investigate about it, that seems to hold all further

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1 00119

2 1 scientific investigation.

3 2 Q Do you have any understanding concerning
 4 3 whether people who, you know, endorse, in some measure,
 5 4 Intelligent Science Theory, are engaged in science?

6 5 A Some of them may be engaged in some types of
 7 6 science. I am not yet persuaded that any of that really
 8 7 bears on Intelligent Designs, because if it did, we
 9 8 would expect to see scientific publications in peer
 10 9 review journals that essentially test hypotheses about
 11 10 Intelligent Design in particular cases.

12 11 Q To your knowledge, I take it, there are none?

13 12 A To my knowledge, there are none.

14 13 Q You've mentioned this notion of testable
 15 14 several times. I want to get a better sense what you
 16 15 mean by that, "testable." Now -- I mean, in what sense
 17 16 is Intelligent Design not testable?

18 17 A If you have an idea that something was whatever
 19 18 intelligently design means, and its proponents are not
 20 19 particularly specific on that point when they're
 21 20 discoursing in venues related to science or education,
 22 21 when you hypothesize something as being intelligently
 23 22 designed, what would be the test of figuring that out.
 24 23 So far, we don't have any tests. How would we know that
 25 24 a structure was intelligently designed?

26 25 Q Well, that's what I'm trying to get. How you

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2 1 approach this. If we look at -- there's two concepts
 3 2 here, I know, that you take issue with, Irreducible
 4 3 Complexity and Specified Complexity. Now, it's my
 5 4 understanding that those are efforts to test the concept
 6 5 of Intelligent Design.

7 6 A They are suggestions, but to qualify as
 8 7 scientific tests, they need to be presented to the
 9 8 scientific community as peer review propositions so that
 10 9 the scientific community could say, hum, yes, well, we
 11 10 agree that if we found such structures or such
 12 11 conditions, we would agree with this; however, that has
 13 12 not been done. Neither proposition has been subjected
 14 13 for scientific peer review. In fact, as I understand,
 15 14 that both -- both ideas have been rejected by the
 16 15 proponents Behe and Dembski for submission for
 17 16 scientific peer review, they're not interested in this.

18 17 Q Let me just understand. In other words, now,
 19 18 it seems like you're saying, well, intelligent -- let's
 20 19 say, Irreducible Complexity or Specified Complexity have
 21 20 been proposed as tests, but they haven't gone to the
 22 21 next level, which is accepted as tests by the scientific
 23 22 community?

24 23 MR. ROTESCHILD: Objection, mischaracterizes
 25 24 his testimony.
 26 25 BY MR. GILLEN:

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1 Q I'm just trying to understand.
 2 A I can put it in my own words.
 3 Q Oh, yes, certainly.
 4 A So they -- Behe and Dembski may have written
 5 about this in popular books and articles.
 6 Q Right.
 7 A That doesn't qualify as the business of
 8 science. If they want to be taken seriously, they have
 9 to do what everybody else does. And what Behe, at least
 10 as a biochemist does, in his own more quotidian, for
 11 want of a better word, biochemical work, like
 12 microquotidian paleontological work, going out and
 13 describing a new species of anything from a rock is what
 14 we do every day. It's reconstructing the phone book of
 15 life.
 16 And, you know, someone like Behe, in his
 17 ordinary biochemical work, would submit that for peer
 18 review. Here you have an idea that he thinks is the
 19 most colossal idea of his scientific career. Why is it
 20 that he hasn't submitted this to peer review? Why
 21 aren't we reading about this from him in the pages of
 22 the most renowned scientific journals? Why aren't the
 23 Nobel people beating the path to his door, and other
 24 people, to award him prizes for this, for
 25 re-revolutionizing our understanding of a huge central

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1 scientific concept? Why are they not even trying?
 2 Q Okay. So let me just look back. I'm looking
 3 at this -- why you have this opinion that Intelligent
 4 Design theory is not a scientific theory. And we're
 5 talking about the testability, and then this other
 6 aspect of scientific, including the sort of communal
 7 element of it, the peer review process. I -- so in
 8 terms of the testability, as I say, it's my
 9 understanding that Behe, through the concept of
 10 Irreducible Complexity, and Dembski, through the concept
 11 of Specified Complexity, are attempting to create
 12 criteria that would test the idea of Intelligent Design
 13 against which that idea can be tested. Do you agree
 14 with that?
 15 A I agree that they are talking about this to
 16 sympathetic audiences.
 17 Q Okay.
 18 A I do not agree that they are proposing it as
 19 science.
 20 Q Okay. Now, in terms of looking at the testing
 21 function, do you agree that they have at least presented
 22 these as tests of their theory?
 23 A No. I agree that they have talked about them
 24 in nonprofessional venues. And I'm not sure that --
 25 forgive me, I would dignify it by calling it proposed.

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1 I could -- to reduce it to the absurd, I could say,
 2 look, I can flip this coin and if it comes up heads,
 3 then this proposition should be accepted. Now, of
 4 course, that's stupid and no one would ever do that, but
 5 I do not see people falling all over each other to look
 6 at what Behe and Dembski have proposed and saying, even
 7 in an informal recognition sense, hey, these are really
 8 good ideas. In fact, the informal criticism, their
 9 informal ideas, has been legion. I'm not seeing anyone
 10 in these communities, as a whole, pick this up and say,
 11 hey, we got to hear more from these guys. Why wouldn't
 12 that be happening if this was a good idea?
 13 Q And I do understand what you're getting at.
 14 I'm just trying to look at these two features and get a
 15 fix on your understanding for Intelligent Design Theory.
 16 Your last response, I take your point, which, as I
 17 understand it, is that, well, present maybe, it may be
 18 presented, but not presented to the relevant -- the
 19 people it should be presented to?
 20 A In a certain way.
 21 Q Okay. So I want to make sure I understand you.
 22 They have offered Irreducible Complexity as a test of
 23 Intelligent Design Theory. That, at least, is something
 24 you agree with? Yes or no?
 25 MR. ROTHSCHILD: Objection. I'm not sure

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 2 what -- you used hand quote marks. I'm not sure what
 3 that was supposed to convey, but it won't be on the
 4 record.
 5 THE WITNESS: Could you say that again?
 6 BY MR. GILLEN:
 7 Q Sure, no problem. Kevin, I want to get to the
 8 nub of this. You've got a basis for an opinion that
 9 it's not science. I understand that. I'm just trying
 10 to figure out where there's a disconnect here. And one
 11 of the things that I understand is that there are
 12 proponents of Intelligent Design Theory, and they, at
 13 least I'm told, are trying to create the test of
 14 Intelligent Design by pointing to criteria, which would
 15 identify Intelligent Design. It's my understanding that
 16 that's why Behe advances the notion of Irreducible
 17 Complexity to make his thesis testable.
 18 MR. ROTHSCHILD: Objection, again. You used
 19 the word "test" in hand motions of quote marks, and I
 20 don't know what that's meant to convey, but it's not on
 21 the written record unless I say something.
 22 BY MR. GILLEN:
 23 Q Do you share that understanding, Kevin?
 24 A No, I don't. I think that it doesn't qualify
 25 for science for two reasons. First of all, the posits
 26 of supernatural agents, which are beyond the reach of

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 2 science. And second, because although they may have
 3 talked about these things and published them informally,
 4 they have not subjected their proposed tests to
 5 scientific peer review. So it is not science, even in
 6 it's potential -- potentially testable features.

7 Q Okay. Maybe I'm understanding you better.
 8 That it's -- in order to qualify as science, in your
 9 opinion, it not only has to have a criteria by which it
 10 can be tested, but that criteria has to be accepted
 11 through peer review process?

12 A And the criteria have to be accepted through
 13 the peer review process. Also, and another important
 14 component, to the extent that this idea involves
 15 supernatural agents, it is no longer the purview of
 16 science.

17 Q And I think I understand you there, but I want
 18 to make sure that I do. When you say "supernatural
 19 agents," what are you referring to there, exactly?

20 A Causes, mechanisms, processes and influences,
 21 that are not part of the normal behavior of the natural
 22 world as we know it. Things that suspend or override
 23 those processes or disrupt them or otherwise influence
 24 them in extraordinary ways.

25 Q Outside of the ordinary laws of nature, as we
 26 know them?

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 2 A Yes.

3 Q Okay. Is it your opinion that Irreducible
 4 Complexity is not a valid scientific concept?

5 MR. ROTHSCHILD: Objection to the form. Do we
 6 have a working understanding of Irreducible Complexity
 7 for purposes of this question?

8 MR. GILLEN: It's in his report.

9 THE WITNESS: If you take a structure that
 10 performs a complex function, and remove some of its
 11 parts and it no longer works, then you can say, well,
 12 it's Irreducible Complexity. That's not the same as
 13 saying that it couldn't possibly have evolved. And yet,
 14 Irreducible Complexity says that it could not have
 15 evolved. That is Behe's notion of Irreducible
 16 Complexity. He states explicitly that this could not
 17 have evolved by natural processes that biologists
 18 recognize.

19 Q In your opinion, I take it, Kevin, that he
 20 is -- that is not the case, that is not true what he
 21 posits?

22 A I think he's going beyond the pale.

23 Q Okay. And exactly in what way?

24 A Because we do not know, or cannot imagine, a
 25 natural way to get from point A to point B, does that
 26 mean, therefore, that we will not discover it, cannot

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 2

3 discover it, or that it could not have happened. Behe
 4 is saying yes to all three. Scientists would say we
 5 can't say that.

6 Q So is it -- is it your understanding that
 7 Behe's concept of Irreducible Complexity is not
 8 scientific because it necessarily entails positing the
 9 unintelligibility of a mechanism of creation or change?

10 MR. ROTHSCHILD: Objection.

11 THE WITNESS: It's positing the impossibility
 12 of a change by natural means alone.

13 BY MR. GILLEN:

14 Q And by that, Kevin, do you mean that he has not
 15 proven anything is irreducibly complex?

16 A He certainly has not proven or shown that
 17 anything is irreducibly complex, that's true.

18 Q Okay. But is that why you're saying here that
 19 it's not a scientific concept because it's -- he's
 20 failed in his proof or because the idea is flawed, which
 21 is it? I'm having a hard time following you.

22 MR. ROTHSCHILD: Objection.

23 THE WITNESS: It's because when you stop
 24 inquiry by saying that it is no longer possible to
 25 search for natural means to explain A to B, you are
 26 effectively removing the inquiry from the domain of
 27 science. And I'm not sure you can be that peremptory

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 2

3 about the cases that have been exemplified or that would
 4 be presented to students in school through things like
 5 Pandas.

6 Q That's what I'm trying to get at. Is it that
 7 you think there is the concept of Irreducible Complexity
 8 hasn't been demonstrated scientifically so that it
 9 cannot be presented as a scientific concept?

10 A That's part of it, yes.

11 MR. ROTHSCHILD: Can I have a standing
 12 objection? Because you've asked a lot of questions
 13 where you take a current proposition that is the subject
 14 of discussion and characterize it as the reason. And I
 15 think Kevin has repeatedly said multiple reasons, as he
 16 just pointed out. I just want to make sure that the
 17 record reflects that when you're focusing on a singular
 18 reason, that it doesn't -- is not treated as a
 19 contradiction of his earlier explanation that there are
 20 multiple reasons why these concepts are not scientific.

21 MR. GILLEN: That's fine.

22 BY MR. GILLEN:

23 Q Forgive me if I'm struggling with this, but I'm
 24 trying to understand, Kevin, why, you know, you have
 25 this judgement that it's not a scientific proposal here
 26 that's being offered. And I'm having a hard time
 27 getting a fix on exactly what is setting it off in your

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2 1 mind as not -- an effort to do science?
 3 2 A First of all, nothing has been shown.
 4 3 Q Okay.
 5 4 A Nothing has been subjected to peer review. And
 6 the idea entails supernatural agents that cannot be
 7 examined by recourse to natural means. For those three
 8 reasons, it's not science.
 9 9 Q Do you have the same three objections to
 10 Specified Complexity?
 11 10 A Yes.
 12 11 Q Any additional objections to Specified
 13 Complexity?
 14 13 A Can't think of any at the moment, but those are
 15 strong enough.
 16 15 Q I understand. Are there -- do you have any
 17 opinion concerning the specific deficiencies in the
 18 concept of Irreducible Complexity as a test for
 19 Intelligent Design?
 20 19 A Yes. One of the things that Behe appears
 21 repeatedly to reject is a very well accepted
 22 evolutionary understanding that the form and function
 23 of one organism can change into a different form and a
 24 different function of the same structure in another
 25 organism. We call that -- another funny word --
 25 exaptation, e-x-a-p-t-a-t-i-o-n. And exaptation is when

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2 1 a structure that is being used for one function becomes
 3 2 co-opted for a second function. Usually, even while
 4 3 it's performing -- continuing to perform the first
 5 4 function. And through time, this second function takes
 6 5 on more importance. Maybe the first function is never
 7 6 entirely lost, but now the second function becomes much
 8 7 more important. And therefore, the whole thing has
 9 8 changed.
 10 9 And Behe, in his description of such processes,
 11 10 seems to take this second new form and function and say
 12 11 that you cannot take parts away from it without having
 13 12 it fail its function and that, therefore, it could not
 14 13 have evolved. But he repeatedly overlooks the
 15 14 possibility in the vast literature from the
 16 15 paleontological record, for example, showing that we do
 17 16 see transitions in form and function to very complex
 18 17 things that we don't think evolved out of nothing, but
 19 18 rather, switched their form and function through
 20 19 lineages. We have a number of examples of these things.
 21 20 And it's -- it's frustrating to many
 22 21 biologists, as you'll learn from Ken Miller and other
 23 22 people, that these criticisms incredibly basic and fatal
 24 23 criticisms of his idea, have not been addressed by him.
 25 24 Q Is the process that you've outlined for the
 25 precursor to the feather, is that an example of ex --

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2 1 A Exaptation.
 3 2 Q -- exaptation?
 4 3 A Yes. The simplest form of the feather, even in
 5 4 its hair-like filamentous form, shows us that it had to
 6 5 be important in insulation. Well, feathers are still
 7 6 important in insulation. But they also enable birds to
 8 7 fly.
 9 8 Q So is it your opinion, Kevin, that Irreducible
 10 Complexity is not tenable as a test of Intelligent
 11 Design because of the possibility of exaptation?
 12 11 MR. ROTHSCHILD: Objection.
 13 12 THE WITNESS: I'm only saying that Behe has
 14 13 not -- has not taken into account the ubiquity of
 15 14 exaptation in explaining complex structures and
 16 15 functions.
 17 16 Q And that ubiquity, did you mention it as an
 18 17 evidence in paleontology, is it evidence in the fossil
 19 18 record?
 20 19 A Yes.
 21 20 Q Is there a biological or microbiological
 22 21 account for processes of exaptation?
 23 22 A In fact, if you want to talk about feathers, it
 24 23 turns out that the development of the feather, that is
 25 24 how it develops from a single little placket on the skin
 25 into a plume with vanes and barbs and barbules, and all

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2 1 these wonderful structures, that this is essentially
 3 2 mirrored in the development of the feather; that is to
 4 3 say, the evolution of feathers as we see them in the
 5 4 fossil record is, to a great extent, mirrored by the
 6 5 development of the feather on a bird today. And these
 7 6 feathers -- what makes these feathers form and how they
 8 7 open up and form on their axis and bifurcate, and do
 9 8 all these things, the genes that control this now are
 10 9 very largely known.
 11 10 I believe I referred to a paper or several
 12 11 papers in my report by Rick Prum, Prum and Williams, and
 13 12 Prum and Brush, and some of their colleagues, in which
 14 13 then explained these things quite nicely. And there's
 15 14 an example where the genes really do tell us how these
 16 15 structures came to be the way they are, what genes
 17 16 actually control this.
 18 17 Q How about Specified Complexity? Does -- I
 19 18 mean, it seems to me that that -- does that effort to
 20 19 create a test for Intelligent Design, does that fail
 21 20 because of exaptation?
 22 21 A No. It fails because it uses a completely
 23 22 inappropriate model of evolution as we understand it.
 24 23 Q And is that the probability calculus that you
 25 24 reference in your expert report?
 25 A Yes.

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1 Q And you see that as a fatal, sort of
 2 methodological flaw in positing the evolutionarily
 3 probabilities?
 4 A Because it doesn't describe the process of
 5 evolution as we know it.
 6 Q When you say that, are you referencing the
 7 portica of your report that talks to the way in which
 8 the certain changes are maintained in the genes?

9 A Yes.

10 Q Such that the probabilities are -- it's not
 11 starting over each time?

12 A Correct.

13 MR. ROTHSCHILD: Does anybody need a break
 14 here?

(Recess.)

14 BY MR. GILLEN:

15 Q Kevin, I've marked something here -- what is
 16 it, it's two; isn't it?

17 A Two.

18 Q All right. And I'd ask you, if you would, to
 19 look at couple of indented --

20 A Yes.

21 Q -- paragraphs there.

22 And particularly, the indented paragraphs that
 23 begin at the bottom of the first page and carry over,

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1 four indented paragraphs.
 2 A The first paragraph is pretty funny. Just
 3 because it's says it identifies Intelligent Design as
 4 another theory of evolution. That's complete nonsense.
 5 That simply doesn't compute. It wouldn't be
 6 identifiable as that to any scientist. It has
 7 absolutely no track record. It's not on the table as
 8 something scientific, let alone a theory, which is the
 9 strongest construct in science.

10 MR. ROTHSCHILD: Kevin, can you just be clear
 11 about which paragraph you're talking about?

12 THE WITNESS: This is the one about the biology
 13 curriculum, and it's also been updated. And the
 14 paragraph begins, 'Students will be made aware of
 15 gaps/problems in Darwin's theory,' et cetera.

16 BY MR. GILLEN:

17 Q Okay. So -- and there, Kevin, if I understand
 18 you, you're basically saying Intelligent Design Theory,
 19 as you know it, is not a theory of evolution?

20 A It's not a theory at all. It's not a
 21 scientific theory at all. And it's certainly not
 22 doesn't have any standing as a -- as any concept in
 23 evolution. It's a concept of antievolution.

24 Q And then when you say, 'It's not a scientific
 25 theory at all,' what do you mean by that?

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1 A By theory -- and if we can, I think --
 2 Q It's there, I believe.

3 A Yes. "A theory is defined as a well-tested
 4 explanation that unifies a broad range of observations."

5 Q Okay. Do you accept that definition of theory
 6 as a plausible working definition of the term?

7 A It's a good general definition of a theory in

8 science.

9 Q Okay. And you've expressed an opinion that
 10 Intelligent Design Theory is not a theory at all?

11 A Right.

12 Q Explain why you have that opinion, Kevin.

13 A First of all, it's not tested. Second of all,
 14 it doesn't explain anything. And third, it does not
 15 unify a broad range of observations.

16 MR. ROTHSCHILD: Just for the record, the
 17 definition that's being referred to is actually in the
 18 document, Exhibit 2, and is on the bottom paragraph of
 19 page 1 of that document, part of the statement read to
 20 students.

21 BY MR. GILLEN:

22 Q All right. If you look at those four
 23 paragraphs that start at the bottom of the first page of
 24 Exhibit 2 and carry over.

25 I'm going to represent to you, for the purposes

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1 of the deposition, that this is the statement you
 2 referenced earlier that's read to the students.

3 A Yes.

4 Q Now, my -- in your report, there's a number of
 5 places where you refer to Intelligent Design being
 6 taught or Intelligent Design being presented. And I can
 7 tell you that this is the sum total of the presentation
 8 to students in the classroom. What I'm trying to get at
 9 here is, does this -- knowing that, knowing that this is
 10 the sum total of the impact on classroom instruction,
 11 that follows from the curriculum change, do you have the
 12 same opinion concerning the decision made by the Dover
 13 Area School District to present Intelligent Design
 14 Theory to the students?

15 MR. ROTHSCHILD: Object to the form of the
 16 question. I think it mischaracterized the evidence by
 17 saying it's the only impact. I will agree that, to
 18 date, this is -- the statement is the only words said to
 19 the students in the classroom.

20 BY MR. GILLEN:

21 Q Okay.

22 A With that understanding, I believe, also
 23 antecedent to this statement, there was a statement in
 24 the curriculum.

25 Q That's true, but the students don't see that.

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2 1 A It doesn't matter.
 3 2 MR. ROTHSCHILD: Object to that
 4 3 characterization.
 5 4 THE WITNESS: It doesn't matter, I think, if
 6 the students see it or not. It matters that it's there
 7 and it has an effect on teaching, because the teachers
 8 are supposed to see it. And therefore, it will
 9 determine what and how they present biological topics in
 10 the classroom. So it -- I think it does have an effect
 11 on instruction.
 12 BY MR. GILLEN:
 13 12 Q Tell me what you think -- what effect do you
 14 think it has?
 15 14 A Do you have a copy of the statement handy?
 16 15 Q That's it.
 17 16 A In the curriculum?
 18 17 Q No. Oh, that's right there.
 19 18 A I'm sorry. That's the one?
 20 19 Q Yes.
 21 20 A "Students will be made aware of gaps/problems
 22 in Darwin's theory."
 23 22 First of all, this is assuming that there are
 24 gaps and problems with Darwin's theory, and that these
 25 were not already emphasized and/or that they should be
 26 emphasized, and that they should be emphasized more than

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1 1 00139
 2 1 you've --
 3 2 A Okay.
 4 3 Q -- we're -- we're concerned with the
 5 presentation of biology and evolutionarily theory in the
 6 classroom. And you have a sense that this statement in
 7 the curriculum is going to influence that presentation
 8 of biology, which is the actual subject matter that's
 9 taught in the classroom. And I'm trying to figure out
 10 how.
 11 10 A If you presume that teachers are expected to
 12 follow the curriculum, then it follows that what is in
 13 the curriculum will be what should be taught and,
 14 therefore, is taught in classrooms.
 15 14 Q And when you say, "should be taught" and "is
 16 taught," are you referring to Intelligent Design?
 17 16 A I'm talking about anything that's in the
 18 curriculum. A good teacher's job is to follow what's in
 19 the curriculum. Teachers know that if they don't follow
 20 what's in the curriculum, they can be reprimanded or
 21 even dismissed. So if this is officially in the
 22 curriculum, then it must be considered important and it
 23 should be followed by the teachers, therefore, it will
 24 be pursued in classroom instruction.
 25 24 Q Do you know whether the teachers have been told
 26 not to teach Intelligent Design?

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1 1 00138
 2 1 any gaps in any other theory in science. For example,
 3 2 gravitation, cosmology, relativity, whatever theories
 4 3 are being present. Why is evolution being roped off
 5 4 here and considered separately?
 6 5 Second, this curriculum statement represents
 7 6 that Intelligent Design is a theory, a scientific
 8 7 theory, which it is not, and that is the theory of
 9 8 evolution, which is it not. It is a theory that denies
 10 9 evolution and posits divine intervention.
 11 10 So, I think, to begin with, Pat, that's
 12 11 something that it may be transparent or not seen
 13 12 specifically by students, but it definitely will have an
 14 13 effect on how biology is taught if teachers follow these
 15 14 instructions.
 16 15 Q Well, let me ask you about that, Kevin. What
 17 16 is the impact that you see on the classroom instruction?
 18 17 A One thing, which we discussed before, is that
 19 18 it makes the presumption that Intelligent Design is
 20 19 somehow incompatible with evolutionarily theory, which I
 21 20 think is a religious notion. And it probably isn't even
 22 21 a correct religious notion for most Americans. I'm not
 23 22 really sure that you can admit it here as a statement
 24 23 about science in the first place.
 25 24 Q But, I mean, I'm trying to get focused on the
 26 25 classroom instruction, because you've -- you know,

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1 1 00140
 2 1 A If they have been taught to teach Intelligent
 3 2 Design, then that countermands what this says in the
 4 3 statement in the curriculum, because it says that
 5 4 students will be made aware of Intelligent Design.
 6 5 Q Okay. Well, let's look at that. I mean,
 7 6 I'm -- let's -- you focus on the curriculum statement,
 8 7 let's look at that. "Students will be made aware of
 9 8 gaps/problems in Darwin's theory."
 10 9 Do you have any understanding concerning
 11 10 whether there are any gaps or problems in Darwin's
 12 11 theory, is there?
 13 12 A There are problems with every theory, but it's
 14 13 all in how you conceive what Darwin said. There are
 15 14 many ways to develop, elaborate, and test what Darwin
 16 15 said, but Darwin is not the only person who has
 17 16 contributed to evolutionarily theory. It's been close
 18 17 on 150 years since the origin of species. A lot has
 19 18 happened since then.
 20 19 Q Sure.
 21 20 A So if you take that entire corpus and say, are
 22 21 there any things that we don't know yet. Well, of
 23 22 course, there are. We could say the same thing about
 24 23 gravitation. Is there a fifth force? That keeps coming
 25 24 up. About relativity. I don't even know what -- a lot
 26 25 of extreme theory and things in physics are, but I know

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 2 I there's lots of problems with every major scientific
 3 theory we have. Otherwise, we wouldn't have the need to
 4 do it anymore, we could all good home.

5 4 So these are -- as far as gaps and problems,
 6 5 yeah, there are gaps and problems. We see these things,
 7 6 good things, for inquiry. As opposed to the connotation
 8 7 here, which is clearly, it seems to me, one of
 9 8 deficiencies or inadequacies or incorrectnesses.

10 9 Q Okay. It's based on that sense that you have,
 11 10 that you find this problematic?

12 11 A In part.

13 12 Q What else?

14 13 A Well, in -- as I've said before, it's -- it's
 15 14 treating Intelligent Design as a theory of evolution.
 16 It is telling teachers to make students aware of
 17 18 problems with what they call "Darwin's theory," but not
 19 20 of problems with Intelligent Design, because the
 20 21 prepositions they're using are different. They're made
 21 22 aware of gaps and problems in Darwin's theory. They
 22 23 don't say "and in other theories of evolution." But
 23 24 they say "and of" recurring to -- "students will be made
 24 25 aware of other theories of evolution."

25 There are no other theories of evolution. And
 26 to represent that to teachers in a curriculum and ask
 27 them to represent that to students in a classroom is

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1 1 means the same thing.
 2 2 Q Where do you get that from, Kevin? What

3 3 accounts for that?

4 4 A Vast experience of 25 years of working with
 5 5 creationist literature in California and elsewhere.
 6 6 Work, for example, with my nonprofit. Works with --
 7 7 before the nonprofit was formed when we were trying to
 8 8 keep creation science and anti-evolutionism out of the
 9 9 textbooks in California. That traces back to 1984, '86.

10 10 Q Do you have an understanding concerning whether
 11 11 Intelligent Design theory takes issue with the origins
 12 12 of life?

13 13 A Well --

14 14 MR. ROTHSCHILD: Objection.

15 15 BY MR. GILLBN:

16 16 Q Let me -- when you say, "origins of life," what
 17 17 do you mean by that, Kevin?

18 18 A What I mean -- when scientists speak about the
 19 19 origin of life, they don't use "origins," plural. They
 20 21 mean the first formation of the first living thing way
 21 22 back billions of years ago. We don't mean the origin of
 22 23 man or the origin of birds in the same, somehow, format.
 23 24 We mean the evolution of those things, but where life
 24 25 begins is the origin of life, and it has only one
 25 26 origin, as far as we know. And therefore, in that

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 2 1 fallacious. It's misleading. It's mendacious.

3 2 Q Now, do you -- let me ask again, Kevin. Do you
 4 3 know whether Intelligent Design is presented as a theory
 5 4 of evolution to students at Dover Area High School?

6 5 A Whether it has been presented as yet, I don't
 7 6 know. What I'm given to understand is that because
 8 7 teachers refused to follow this directive, that
 9 8 administrators came in and read the following four point
 10 9 or four paragraph statement to the students in the class
 11 10 with no discussion, no objection, and left.

12 11 Q Okay.

13 12 A Is that -- that's my understanding.

14 13 Q That is, and that's accurate.

15 14 If you look at that four paragraph statement,
 16 15 do you see that statement as holding out Intelligent
 17 16 Design as a theory of evolution?

18 17 A Yes.

19 18 Q Where?

20 19 A In the third paragraph it says, "Intelligent
 21 20 Design is an explanation of the origin of life that
 22 21 differs from Darwin's theory."

23 22 Darwin's view was not of the origin of life; it
 24 23 was of how species evolved. But in creationist's
 25 24 parlance, the words "origins" and "evolution" are
 26 25 constantly conflated. So this is code language, and it

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1 2 continuity of life, when we talk about the origin of
 2 3 birds, we mean the evolution of the first birds from
 3 4 things that were already preexisting. But life is
 4 5 coming out of things that are non-life, the study of the
 5 6 origins -- of the origin of life. The "origin of life,"
 6 7 singular, is a very knotty problem that depends on very
 7 8 indirect sketchy evidence that can be formulated, as
 8 9 we've seen, in several different ways. And there are
 9 10 some very interesting and different hypothesis about
 10 11 lots of processes, the origin of life. So when
 11 12 scientists talk about it, it's just the single origin of
 12 13 life billions of years ago.

13 14 So here, in this paragraph, Intelligent Design
 14 15 is an explanation of the origin of life that differs
 15 16 from Darwin's view. Darwin didn't write his book about
 16 17 the origin of life. He wrote his book about how new
 17 18 species evolved from preexisting species. So these
 18 19 things all become conflated in anti-evolutionist
 19 20 language. And this is typical anti-evolutionist
 20 21 writing.

21 22 Then they go on to talk about Pandas and People
 22 23 and promote this as a reference for the explanation of
 23 24 life, by which they mean evolution or origins, whatever
 24 25 parlances they feel like using. This is where the
 25 26 problems lie. Because as -- you asked the question, are

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1 they promoting Intelligent Design. Yes, that third
 2 paragraph is entirely about substituting Intelligent
 3 Design for a full explanation of Darwinism, or whatever
 4 Darwin's theory entails to them, which is really quite a
 5 different approach or understanding than scientists
 6 have.

7 Q Okay. And again, I want to get a grasp on
 8 this. It seems like, looking at that third paragraph or
 9 the four paragraph statement, when you see the term
 10 "origin of life," you're looking at that in terms of
 11 your sort of background knowledge of this creationist
 12 evolutionist debate. And you're saying that you
 13 understand that term, "origin of life," to be a
 14 reference to origin of the species?

15 A It encompasses not just the original origin of
 16 life, but also the emergence of major body plants and
 17 adaptations, major groups of organisms as well,
 18 including humans.

19 Q Okay. And if you look at -- I see that you
 20 have this objection that by just referencing the book of
 21 Pandas, students are what, they're --

22 A By referencing Pandas, the school board is
 23 legitimizing this as a source of knowledge about
 24 biological evolution. It's legitimizing the idea that
 25 there are scientific alternatives to evolution, and it's

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1 legitimizing Intelligent Design as one of those
 2 alternatives.

3 Q Okay. Is there anything else in this statement
 4 that you think is problematic, from the standpoint of
 5 good science education?

6 A Well, we could talk about why they're confusing
 7 the scientific and common uses of the terms "theory" and
 8 "fact." And this makes it very problematic because it
 9 prejudices, in advance, examination of not just Darwin's
 10 theory or the whole theory of evolution, which is way
 11 more than Darwin's, but any scientific theory. It gives
 12 the impression that the school board believes that a
 13 theory, at some point, becomes a fact, perhaps when it's
 14 proven or otherwise demonstrated beyond all doubt. That
 15 is not at all what we mean in science when we use the
 16 terms "fact" and "theory."

17 And if students were given the impression that
 18 this is the case, they would be misled. And I believe
 19 this would thwart the school board's stated purpose of
 20 helping them to prepare well for standardized tests.

21 Q Well, what are you getting at there, Kevin? Is
 22 there no distinction between theory and fact?

23 A There is a distinction but, in fact, oddly
 24 enough, to a scientist, a fact is a much more trivial
 25 thing than a theory. A fact is simply a reported

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1 observation. It could be wrong. Facts are wrong all
 2 the time. Facts are not true. The school board's
 3 wording gives the impression that a theory becomes a
 4 fact. That is, that it becomes true after it has enough
 5 evidence to support it. But, actually, a fact is just a
 6 small component of a theory. It's an observation. Many
 7 observations are made. Many inferences are made. Many
 8 hypotheses are drawn from those inferences and tested
 9 repeatedly.

10 Many different disciplines can be pursued as
 11 they are relevant to exploring the consequences of this
 12 building mass of ideas. That eventually becomes a body
 13 we call a theory. When it seems like it's a pretty good
 14 idea that, for the moment, we're going to -- until
 15 something better comes along -- we're very pragmatic
 16 about this -- we're going to accept it as the best
 17 explanation we have.

18 So a theory, like a theory of -- I guess, I
 19 might call plate tectonics, which emerged from the old idea
 20 of continental drift. Plate tectonics is a theory because
 21 it doesn't just say that continents drift around through
 22 time, it gives mechanisms for those movements which we
 23 didn't have before. It shows how the plates of the
 24 earth are drawn back into the earth; how they come up
 25 against each other and build mountain ranges; how this

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1 makes earthquakes and volcanoes and rings of volcanoes,
 2 for example, as we see around the Pacific continental
 3 rims.

4 The consequences of all this don't just apply
 5 to the surface, but they apply to our understanding of
 6 what goes on deep inside the earth where there are
 7 convection currents of heat, heated hot molten rock,
 8 hundreds of miles, thousands of miles, thick, coursing
 9 through the inside of the earth and erupting and causing
 10 these processes on the surface. There, in that whole
 11 thing I described, is the embodiment of the theory.
 12 Would any single fact come along and slay that theory?
 13 It's hard to think of one that would.

14 But the theory itself later on could be
 15 modified in any number of ways. Perhaps we'll learn
 16 that the relationship of the sun and the moon to earth's
 17 gravitational field is what -- that may provide another
 18 explanatory mechanism. It may take our focus off
 19 convective -- who knows what. We don't know where this
 20 is going to go, but the fact is that evolution is a
 21 theory that's just like that. We're as certain as we
 22 can be that this is a really good explanation of the
 23 diversity of life on earth. Does that mean we know
 24 everything about it? No. Does it mean we won't find
 25 new mechanisms? Of course, we will. Does it mean that

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1 existing mechanism we have now, we may find more or less
 2 important than the past? Of course not. All this, the
 3 more we study, the more we'll learn. And that's how
 4 science operates.

5 Q In your opinion, is there a possibility that
 6 that sum total of facts could, at some point, displace
 7 evolutionarily theory?

8 A Because scientists are legendary in being
 9 open-minded, the answer that I would be expected to give
 10 is, yes, obviously. But I think I should stress that
 11 science is open minded, but not empty-headed. And that
 12 means that we know a lot, and if we have this huge body
 13 of knowledge, there are two things that could displace
 14 it. One is, we'd have a bigger body of knowledge that
 15 says all this is wrong. Or, we could have some other
 16 observations and ideas that would take that body of
 17 knowledge, twist it 45 degrees and say, now we can
 18 explain it this way and it makes even more sense. And
 19 that's a paradigm shift. But to destroy a whole theory
 20 like the phlogiston theory -- that's p-h-l-o-g-i-s-t-o-n
 21 theory -- seems awfully unlikely in view of 150 years of
 22 research.

23 Q The accumulated successes of evolutionarily
 24 theory is such that you think it's unlikely that it will
 25 ever be displaced as the reigning theory in this area?

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1 A It may be modified, but to be completely thrown
 2 out, would be unlikely.

3 Q If you look at -- I'm sorry, Kevin.

4 A And I want to say in fairness, I don't think
 5 that ID is trying to do that.

6 Q What do you see it trying to do?

7 A I see it trying to add a certain special kind
 8 of explanation to the understanding of evolutionarily
 9 theory. That does not mean that all of its adherents
 10 accept or do not accept evolution as a fact or
 11 evolutionarily theory, as we know it today. But it does
 12 mean they're trying to add another explanation here that
 13 they think may displace it.

14 The language of these documents suggests that
 15 it is supposed to displace it. And as we discussed
 16 earlier, it's not clear why Intelligent Design has to be
 17 in conflict with evolution except that they are positing
 18 supernatural intervention, which is non-scientific.
 19 Science can't investigate it. So it comes back to that.

20 Q If we stay focused on this theory fact
 21 distinction, and I look at the bird net hypothesis, how
 22 does that fit in? Is that a theory; is that a fact?

23 A We would call it a hypothesis. That is a
 24 hypothesis of how this evolved, how this structure
 25 changed its function.

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1 Q So there's neither fact nor theory there?
 2 A The facts that John used related to the
 3 structure of the first birds and the animals they came
 4 from; reasonable inferences about how their arms and
 5 legs moved, for example, how they could run, how they
 6 might move their arms; facts about what we knew then
 7 about the feathers of early birds and possible precursor
 8 structures.

9 So there were, of course, facts that he used to
 10 develop a hypothesis that then required further testing.
 11 And as we talked about before, one test of that was
 12 proposed by our colleagues in Arizona. And it was --
 13 was persuasive with recourse to the evidence enough to
 14 suggest to John, and to the others, that maybe his
 15 proposal was not really explaining very much, and he
 16 agreed.

17 Q Well, and just to get -- you called that a
 18 hypothesis. Is it not a theory because it unifies a
 19 lesser range of observations; is that it?

20 A Yes.

21 Q Okay.

22 A It has a much simpler test to it.

23 Q So just as I try and labor through this, from
 24 your standpoint, Kevin, when it says, 'Darwin's theory
 25 is a theory,' that is accurate, I guess?

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1 A (Witness nods head.)

2 Q Is that?

3 A Yes.

4 Q "It continues to be tested as new evidence is
 5 discovered."

6 A Uh-huh.

7 Q That's true?

8 A Uh-huh.

9 Q The theory is not a fact is literally true, at
 10 least, but you've expressed these reservations because
 11 you think it conveys a misleading sense of what the term
 12 should mean?

13 A If someone said, is it a fact that life has
 14 evolved through time, I would say, yes, because it's a
 15 well-accepted understanding. Is it a fact that natural
 16 selection is important in the evolution of life? I
 17 would say, yes, because it's a well-tested observation
 18 in natural populations and in laboratory populations.
 19 We know that selection in these populations can have a
 20 very strong effect. So we do regard that as a fact,
 21 that selection is important in evolution.

22 Q Okay. So I guess you're saying some features
 23 of a theory are so well demonstrated that they are a
 24 fact?

25 A Yeah, they're factual. Life has a common

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2 1 ancestor, and all of life has evolved through time.
3 2 These are propositions that the scientific community
4 3 accepts by consensus. I would say, it's not necessary
5 4 that every scientist in the world accepts all these
6 5 things, or everyone who calls themselves a scientist
7 6 accepts all those things, but it is the universal
8 7 scientific consensus in countries, races, cultures, that
9 8 operate in science. So the second sentence there is
10 9 very problematic.

11 10 Q Then 'gaps in the theory exist for which there
12 11 is no evidence.'

13 12 A 'Gaps in the theory exist for which there is no
14 13 evidence.'

15 14 Well, without them saying what the gap is and
16 15 what particular theory they're talking about, it's
17 16 really hard to respond to that. It just seems like a --
18 17 it seems like a kind of a defamatory characterization,
19 18 and that's all.

20 19 Q Do you -- I think you told me, but let me ask
21 20 again. Have you ever spoken with the teachers at Dover
22 21 about what they taught in the classes dealing with
23 22 evolution prior to this statement?

24 23 A I haven't. Sorry, I have not.

25 24 Q Okay. But do you have an understanding as to
26 25 whether there are gaps in evolutionarily theory?

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2 1 enough to tell us, by their rhetoric, what they
3 2 emphasize, what they deemphasize, what they say and what
4 3 they don't say. That these paragraphs are largely there
5 4 to criticize standard evolutionarily theory and to
6 5 represent that there are other ideas that are scientific
7 6 that are equally worthy, that somehow are not being
8 7 presented in the curriculum, but that students can have
9 8 resource to if they just read the Pandas book. And this
10 9 is a gross misrepresentation of science and of geo-
11 10 science education.

12 11 Q Because it's holding out Intelligent Design
13 12 Theory as a scientific theory?

14 13 A And because it's criticizing standard
15 14 evolutionarily theory in completely incorrect and
16 15 inappropriate ways.

17 16 Q It seems to me, Kevin, what you're saying there
18 17 is it seems overstated, the criticisms seems overstated?

19 18 A It's incorrect and biased. It's incorrect to
20 19 imply that evolutionarily theory is completely in chaos
21 20 and has big problems with it that students are not being
22 21 told about in standard curriculum. It's biased in that
23 22 it does not apply this kind of awareness to any other
24 23 idea in the science curriculum or indeed, since it's the
25 24 whole school board, to history, math, social studies. I
26 25 mean, why don't they have a similar statement that says,

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2 1 A 1 by that you mean, are there things we don't
3 2 know yet and are there issues that are still debated.
4 3 Of course, as there is for any theory. The
5 4 characterization of these issues in questions as gaps
6 5 seems to me pejorative and leading.

7 6 Q And when you say that, Kevin, why do you say
8 7 that?

9 8 A It's leading students to believe that things
10 9 are worse than they are. That there is disarray,
11 10 perhaps even deception, that they are not being told of
12 11 problems that exist that are really serious. When, in
13 12 fact, the problems are not serious. Every evolutionist
14 13 who writes for the public, from Stephen J. Gould on
15 14 down, has stress that even though we may argue about
16 15 whether punctuated or gradualism is more or less
17 16 important, we do not deny that these organisms are all
18 17 evolving through time, and they have common ancestors.

19 18 The insinuation that there is complete
20 19 disarray, disagreement, chaos, and lack of understanding
21 20 is simply false. And that is what statements like this
22 21 purvey having nothing in the statement to balance them.

23 22 Q And you're making that judgement, Kevin, based
24 23 on your experience in - with critics of evolution?

25 24 A I'm basing it even strictly on what the words
26 25 in the sentences say here. I think the words alone are

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2 1 well, the holocaust is one idea. But there's this other
3 2 idea that the holocaust is a myth, and you can go to
4 3 this book in your library and read about that.

5 4 Now, historians, as I understand it, although
6 5 I'm happy to have you establish that I'm not a
7 6 historian, would be almost universal in their
8 7 condemnation of the holocaust myth notion. Yet we find
9 8 many people in this country who are comfortable with it.
10 9 If we represent that to children as being an equally
11 10 good idea about an important history, important event in
12 11 the last century's history, and that we represented this
13 12 view has strong evidentiary support for it among the
14 13 community of scholars that are historians, which should
15 14 be what we teach in schools, I think that if you made
16 15 that substitution, a lot of the parents in Dover would
17 16 say, you know, you're right, this isn't fair.

18 17 Q And you get the implication from the second
19 18 paragraph of the statement read to students?

20 19 A And the third one and the fourth one, which
21 20 suggests that with respect to any theory, "students are
22 21 encouraged to keep an open mind." And yet, the board
23 22 does not address any other theory in any other
24 23 curriculum or this one. It's only this one that they
25 24 want students to keep an open mind about.

26 25 Q When you say that, Kevin, is it based on your

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1 1 understanding that this notion of keeping -- "students
 2 are encouraged to keep an open mind" is limited to
 3 evolutionarily theory?

4 A This is the only theory under discussion in the
 5 board's statement.

6 Q I think you said there's no -- you're not
 7 really familiar with any other -- the presentation of
 8 any other theories in Dover Area High School?

9 A I'm not familiar with any other statement the
 10 school board makes with respect to keeping open minds
 11 about, or in considering alternative theories that are
 12 not part of the standard curriculum.

13 Q Standard curriculum, meaning what?

14 A I presume that the teachers are working either
 15 from a state curriculum, a district curriculum, or from
 16 another stand curriculum that the board has accepted as
 17 something they should be dealing with. In either of
 18 these cases, I would define those as standard
 19 curriculum.

20 Q Let me ask you, on page 4 of your report,
 21 you've got the one, two, third paragraph down there, it
 22 says, if IBC were presented in science class as if it
 23 were science, and then you number -- number of
 24 consequences that you see following from that. The
 25 first is that students would completely misapprehend

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2 1 practice, that sort of practical consequence of that
 3 2 curriculum change, would present this harm, that
 4 3 "students would completely misapprehend the structure
 5 4 and logic of science"?

6 A One is tempted to wonder where it would end.

7 Do you have the principal coming into the social studies
 8 class the next day and saying that, well, what you read
 9 here about European Imperialism and Colonialism in your
 10 history book is all well and good, but there's another
 11 theory that actually this is -- this was the manifest
 12 destiny of a superior European race that had a destiny
 13 and a legacy to concur everything in front of it, which
 14 is the way history was taught in the eyes of the people
 15 now writing it in decades previously.

16 Where will this end if you allow the whim of a
 17 special-interest-issue group to come in and simply
 18 countermand or contradict by virtue of the authority of
 19 a teacher reading this or a school board member or an
 20 administrator from school, coming in with the bravadoes
 21 of his position and saying, all of what you're hearing
 22 now, you know, there's a whole other side to this.
 23 I find that that's just the poorest education
 24 practice I can think of. If you really had good
 25 evidence, it should be presented, assuming that it's
 26 scientifically valid. And students should understand

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2 1 this structure and logic of science.

3 Now, we've gone through this statement, and
 4 that -- this is, I can tell you, the statement that's
 5 read at the beginning of the biology classes that deal
 6 with evolution. Do you believe that the reading of this
 7 statement would present this harm that I've just
 8 described from your report, "students will completely
 9 misapprehend the structure and logic of science"?

10 A Well, my paragraph says, Pat, that "if IBC were
 11 presented in science classes as if it were science." So
 12 my statements there are not applying specifically to
 13 simply walking into a classroom and reading this
 14 statement. So, for all I know, the guy could walk in,
 15 read the statement, walk out, the kids would go, huh,
 16 and then just go back to their video games or whatever
 17 they're doing.

18 Q Right. Well, I understand that, and that's why
 19 I'm asking you. I mean, the situation you described is,
 20 I think, you can -- let me say for the purpose of this
 21 question, assume that that's exactly what happened. The
 22 administrators walked in, they read the statement and
 23 walked out, and the teachers went on to give
 24 instruction, and that instruction was in evolutionary
 25 theory as it had been taught for 20 years at Dover.

26 My question is, do you think that that

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2 1 Why this is so, and should discuss it. But I think it's
 3 2 a matter of established fact among us that there was no
 4 3 discussion of this, nor did anyone feel a discussion was
 5 4 appropriate.

6 Q Well -- and I understand. I'm just trying to
 7 get a sense for the way in which the report relates to
 8 what's happening. Just to -- let me ask you, because I
 9 know you have a background in science education.

10 A Do you think reading that statement will
 11 present this harm, that it would have such a dramatic --
 12 this sounds to -- this is a serious thing, "students
 13 will completely misapprehend the structure and logic of
 14 science"?

15 A And I -- you know, where they ended up is this
 16 statement. All I want to do is get your opinion. In
 17 your opinion, as a science educator, does the reading of
 18 that statement create that harm?

19 A I am not persuaded that the reading of that
 20 statement is the only or ultimate action that the school
 21 board would take as a result of its curriculum change.
 22 In the short time that it's been in force, we know that
 23 the actions of the school board have met tremendous
 24 resistance and controversy. And that, so far, this is
 25 all they have felt able to do, perhaps.

26 However, the intent and purpose of introduction

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 2 1 to curriculum change is both religiously motivated and
 3 scientifically untenable. The effect that this has on
 4 instruction is not positive; it's negative. And so I
 5 don't feel that it's a relevant question to ask whether
 6 what they have done so far is harming anyone. I think
 7 that what they would like to do is far more than this
 8 and that it would be harmful. As it's done already,
 9 it's providing misdirection, falsehoods and
 10 misrepresentation of science to students. And you might
 11 say that no one's paying attention to it, and I won't
 12 agree or disagree.

13 The action as such, is poor science. It's poor
 14 pedagogy. It's poor educational practice. And those
 15 things are in of themselves harmful.

16 Q Well, look, I understand that, Kevin, I have
 17 total respect for you, your credentials, your background
 18 in science education, the information you've given me,
 19 frankly, here today. And I know why you might suspect
 20 that other actions might be taken down the road. I can
 21 understand that given the sources of information that
 22 you've had. But I just want you to answer that question
 23 that I've asked you. Which is, you know, if the -- this
 24 reading of the statement, in your opinion, as a science
 25 educator, does the reading of that statement create the
 26 harm that I've identified here, in your opinion, on page

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 2 1 is, and what -- one thing, for example, is that the
 3 2 Pandas book is full of alleged questions, conundrums,
 4 3 and unsolved problems of evolution, as scientists
 5 4 understand it.
 6 5 These, as I've detailed over many pages, are
 7 6 complete misrepresentations of the science, and they
 8 7 were when the book was written. So I would say for that
 9 8 on the first count, yes, if they did that, they would
 10 9 completely -- if they read Pandas and People, as they're
 11 10 told to do in class, it would completely misrepresent --
 12 13 I'm sorry, they would completely misapprehend the
 13 12 structure and logic of science.

14 14 Q Would they, if they didn't read Of Pandas?
 15 15 A I can't tell whether they would or would not.
 16 16 It sure wouldn't help.

17 17 Q How about just the same thing for 2 there,
 18 18 'understanding of evolutionarily biology would be
 19 19 deficient and misinformed'?

20 20 A Yes.
 21 21 Q 'And their training in science would be
 22 22 significantly inferior to that of other schools and to
 23 23 schools in other countries.'
 24 24 If we look at the students there, and we posit
 25 25 that they heard the reading of this statement but didn't
 26 read Of Pandas, do you think that harm would flow from

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 2 1 4, that students would completely misapprehend the
 3 2 structure and logic of science?

4 3 MR. ROTHSCHILD: We's answered that.
 5 4 THE MICHIGAN: Remembering again, that my
 6 5 statement referred to if IDC were taught as science.
 7 6 But the reading of that statement, if people listened to
 8 7 it, and if a tree falls in a forest and no one hears it,
 9 8 we could debate that, but if people listen to it -- if
 10 9 it is meant to be listened to and heeded, then it would
 11 10 create harm.

12 11 I cannot tell you if students listen to it and,
 13 12 therefore, if it has created harm. That's not in my --
 14 13 I don't have that experience directly to judge.

15 14 Q All right. Let me ask you this. If the
 16 15 statement were read, and if the statement was heard by
 17 16 the students, in your opinion as a science educator,
 18 17 would it -- would students completely -- did those
 19 18 students who heard it completely misapprehend the
 20 19 structure and logic of science?

21 20 A They would -- they would misunderstand,
 22 21 misapprehend what the structure of science is. Because
 23 22 if they heeded the statement, listened to it, and went
 24 23 and read Pandas and People, which is what the statement
 25 24 tells them to do, they would misapprehend what
 26 25 scientific understanding is, what the logic of science

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 2 1 the reading of that statement.
 3 2 A I can't tell.
 4 3 Q How about taxpayer dollars would be wasted? I
 5 4 mean, what's your -- what are you getting at there,
 6 5 Kevin?

7 6 A When students are introduced to false
 8 7 controversies, when they are told things that are
 9 8 misrepresentations of the understanding that's standard
 10 9 curricular are trying to get across, then tax payers'
 11 10 dollars are wasted. You're wasting time, you're wasting
 12 11 effort, you could be teaching them good science, good
 13 12 social studies.

14 13 Q On page 6, there's a paragraph that begins,
 15 14 that says, 'If school children were taught according to
 16 15 IDC precepts, they would learn that a complex structure
 17 16 would be useless until it was fully formed.'

18 17 When you say, 'taught according to IDC
 19 18 precepts,' Kevin, what -- what do you have in mind?
 20 19 A Specifically Specified Complexity and
 21 20 Irreducible Complexity, which are the hallmarks of
 22 21 Intelligent Design Creationism, as we understand it.
 23 22 Q Do you have any understanding concerning
 24 23 whether the students at Dover High School are taught
 25 24 those concepts?
 26 25 A You tell me that, so far, only this statement

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 2 1 has been read to them. I respond that, if down the line
 3 2 Intelligent Design were taught as if it were a
 4 3 scientific theory and as if it were an alternative
 5 4 evolution, then these things would happen.
 6 5 Q The reading of the statement alone, would
 7 6 that -- would they learn that a complex structure would
 8 7 be useless until it is fully formed or was fully formed,
 9 8 the statement?

10 9 A The four paragraph statement by itself doesn't
 11 10 address those specifics.

12 11 Q You've got a reference here to -- as that
 13 12 sentence goes on, to the evidence for that a wing would
 14 13 be useless until it was fully formed, and that this is,
 15 14 therefore, evidence of a miraculous intervention of a
 16 15 Master intellect or Creator. If, as I tell you, just
 17 16 for the purposes of these questions, we're limiting to
 18 17 the statement, is that harm still present, in your
 19 18 judgment?

20 19 MR. ROTHSCHILD: Just to be clear, this posits
 21 20 a student who does not go and read Pandas?

22 21 BY MR. GILLEN:

23 22 Q Right.

24 23 A If a four paragraph statement states the term
 25 24 "Intelligent Design," and relates it to discussions
 25 25 about the origin and evolution of life. In those four

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 2 1 paragraphs themselves, they do not directly address the
 3 2 specifics of miraculous interventions.
 4 3 Q Now about -- I mean, I just -- you ventured a
 5 4 number of opinions related to the teaching of some
 6 5 Intelligent Design concepts, Irreducible Complexity or
 7 6 Specified Complexity. As -- I don't want to belabor the
 8 7 process. The statement doesn't get into that, this is
 9 8 what they ended up with. Does -- in your judgment now,
 10 9 if you look at the situation as it's actually, you know,
 11 10 occurred, what's -- what's the end result of this
 12 11 contest between the Board and different facets of the
 13 12 community, does it present the harms that you were
 14 13 concerned about when you drafted your expert report?

15 14 MR. ROTHSCHILD: Objection, asked and answered.

16 15 THE WITNESS: I think that we -- if we can
 17 16 admit, as agreed, that so far this statement has been
 18 17 read by administrators, not teachers, and these
 19 18 administrators then left the classroom, and teachers
 20 19 went on with whatever they were doing, then we also
 21 20 should be able to admit the fact that, as I understand
 22 21 it, there has been a lot of heated controversy and
 23 22 argument in the Dover community at school board meetings
 24 23 and super market aisles, who knows, on telephone calls
 25 24 among people. And who knows the extent of the
 25 25 confusion, misunderstanding and damage that has resulted

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2 1 from the Board's action of taking an unproblematic,
 3 2 straightforward concept, universally accepted by
 4 3 scientific societies and the consensus of scientists,
 5 4 and pretending that it's riddled with problems, and that
 6 5 there's an alternative idea that should be taught
 7 6 alongside it, and should be done.

8 7 I believe if you wish to say, did this action
 9 8 alone create harm, it is not just this action, but the
 10 9 passage of these actions by the Board and the strife and
 11 10 turmoil that has existed and resulted in that community,
 12 11 as a result of this action, that is going to leave a
 13 12 scar on that community for a long time to come no matter
 14 13 how this is decided. And I have to ask myself, is it
 15 14 all worth it to try to take this little special pleading
 16 15 that's not even wrong. It's not even wrong because it's
 17 16 not even science. And to say here, we have to put this
 18 17 on equal footing. What kind of good can that action
 19 18 have inside and outside of the classroom?

20 19 I do not feel it is fair to judge the
 21 20 consequences of the Board's action simply by whether
 22 21 reading the statement in the classroom has caused harm.
 23 22 What has happened in the Dover community, if news
 24 23 reports and everything that you and I hear is any
 25 24 indication, it's a turmoil and confusion, and a
 25 25 misrepresentation that could have been completely

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2 1 avoided.

3 2 Q Okay. Those are sort of extra science
 4 3 education considerations?

5 4 A I don't think so, because I don't think that
 6 5 students only learn in the classroom. I think that they
 7 6 learn a lot from discussions that they have and that
 8 7 they bear outside the classroom. And if this buzz in
 9 8 the community is anywhere near as great as news report
 10 9 would have us understand, you wonder who is guiding that
 11 10 discussion outside the class, which is probably far more
 12 11 than the discussion in class. What other kinds of
 13 12 excuse me.

14 13 If the Dover School Board can be so uneducated
 15 14 and misled about basic science as to take actions like
 16 15 this, what about the other people in the community who
 17 16 don't have their experience and wisdom? I presume that
 18 17 they're on the board because they're regarded as
 19 18 educational leaders in their community. If that's the
 20 19 case, what about the people that don't have their
 21 20 breadth of knowledge and experience? What kind of
 22 21 discourse is being fostered by this confusion among all
 23 22 those people who have no authorities to turn to?

24 23 Q Let me understand you. Is it your view that
 25 24 any discussion of Intelligent Design is harmful?
 25 25 A No. Rather, that the actions of the board have

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1 created a false controversy about science and science
 2 education that have repercussions beyond the time it
 3 takes or the form that it represents to read four
 4 paragraphs by an administrator in a science classroom.
 5 And I think it would be negligent not to
 6 acknowledge that or try to limit the problems or the
 7 damage to what happens to a few students that hear
 8 somebody read this in a classroom.
 9 Q If we focus on the students hearing the
 10 statement read, as we sit here today, are there any
 11 other harm that you can see inuring to those students
 12 in the classroom that follow from the reading of these
 13 statements?
 14 A I believe you would have to ask those students
 15 and their parents and the other members of their
 16 community.
 17 Q Kevin, on page 14 of your report, you say that
 18 "IDC proponents reject the standard methods of science."
 19 A Yes.
 20 Q Just give me a sense for what you're
 21 understanding is in that regard, what methods do they
 22 reject?
 23 A One method, that it restricts examination to
 24 natural phenomena, not supernatural ones.
 25 Q Any others?

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1 A One method of science is, when possible, either
 2 to set up experiments and to carry them out. I have not
 3 seen any experiments carried out with reference to IDC.
 4 Another method would be to use phylogenetic comparative
 5 methods to examine whether the evolution of the
 6 structure could occur or whether, for example, it was
 7 too complex or had too much Specified Complexity to
 8 evolve. I've seen no work done or submitted according
 9 to those methods. And I think one method that applies
 10 to the scientific community that is important to stress,
 11 is its submission to peer review, which has never been
 12 done, as far as I know.
 13 Q Any other methods?
 14 A I can't think of specific cases right now.
 15 They may come up in further discussion.
 16 Q Let me just ask you. Now, if we contrast that
 17 with Darwinian theory, as it's called in the statement.
 18 Evolutionarily theory, I think, as it's known,
 19 apparently, in the professional community today, is that
 20 falsifiable?
 21 MR. ROTHSCHILD: Objection to the form.
 22 THE WITNESS: However we characterize our
 23 evolutionarily theory or Darwinian theory, to say that a
 24 theory is falsifiable would suggest that everything
 25 about it is wrong. Is it testable, are aspects of it

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 2 testable and even falsifiable? Yes, of course, sure.
 3 BY MR. GILLEN:
 4 Q Could there -- let me -- I'm trying to get a
 5 sense for how -- plainly, you see this differentiation
 6 here between Intelligent Design Theory and
 7 evolutionarily theory. And we've -- at several points
 8 today, we've talked about it being testable or parts of
 9 it being testable. And you have the conviction that
 10 there's no testable elements to Intelligent Design
 11 Theory; is that correct?
 12 A What I said is, that the supernatural part of
 13 it is not testable scientifically, because science's
 14 purview is only in the natural world. These things may
 15 or may not be true, but they are not part of science.
 16 Q Are there other parts that are testable?
 17 A There are parts that may or may not be
 18 testable, but they have not been proposed in the
 19 scientific community in testable terms. And that's why
 20 we talked about the idea that Behe and Dembski, for
 21 example, have said certain things or they have written
 22 certain things, but they have not subjected this to peer
 23 review. And even when they've been criticized, they
 24 have not responded in many respects, a problem of which
 25 their critics complain. And so, what these guys seem to
 26 want is -- is "double indemnity" the right word, maybe

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 2 not. They want it both ways. They want to be able to
 3 come in and say that they've got the greatest thing
 4 since sliced bread, but they don't want to say that in
 5 the scientific form, and they don't want to respond to
 6 scientific criticisms in a scientific form.
 7 If this is the case, why is this science? The
 8 process, the de facto nature of science, this isn't it.
 9 This isn't it. They're not doing it.
 10 Q Now, just so I get you, you're contrasting that
 11 with evolutionarily theory, where you said that parts of
 12 it are testable?
 13 A I can think of probably a dozen journals off
 14 the top of my head, in which every aspect of
 15 evolutionarily theory is routinely reported, tested,
 16 modified, enlarged, expanded, and in some cases,
 17 rejected.
 18 Q Okay. But those, as you see it, apparently,
 19 they have no implications for the over arching thrust or
 20 tenets of evolutionarily theory; is that fair?
 21 A No. They have every bit as much.
 22 Q You're right. My question was imprecise. But
 23 in terms of falsifying the theory, they don't pose
 24 significant challenges to the overall standing of the
 25 theory?
 26 A Sure they do. Sure. We can take any number of

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